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CLINICAL AND PATHOLOGICAL SIGNIFICANCE OF OBLITERATION, CARCINOMA, AND DIVERTICULUM OF THE APPENDIX

DEDUCTIONS FROM AN EXAMINATION OF 5,000 SPECIMENS, WITH A COMPARATIVE STUDY OF THE PATHOLOGY AND CLINICAL HISTORIES IN 2,000 CASES [1]

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THE character and significance of obliteration of the lumen of the appendix have been very much disputed since it was first described. The condition was considered a normal physiological involution, by which the organ itself was disappearing. This view was based upon the fact that autopsies in general showed that the percentages of obliterated appendices increased gradually with the increasing decades, and that the mucosa at the point of obliteration was covered by epithelium. This conception of the process was held and advocated by Ribbert, Zuckerkandl, and others. There were, however, many investigators who from the beginning of the study of the process believed it to be inflammatory.

Ribbert and his followers either have given or are giving up the involution theory of obliteration and favoring that of an inflammatory process. It may be stated that the majority of, if not all pathologists, now consider the process the result of infection.

The occurrence of obliteration in a large series of cases is of interest and importance when considered from the following standpoints:

1. Is obliteration the result of an inflammatory process, or is it a normal physiological involution?

2. How often does partial or complete obliteration occur at autopsy in general, operation for appendicitis, and in association with other abdominal pathologic conditions?

3. What are the earliest ages at which obliteration is found to start and to be completed? What are the latest ages?

4. What are the average ages of total [2] obliteration, and tip obliteration?

[2] "Total obliteration in this paper means absence of the lumen in the specimen in the laboratory. On account of the method of remova of the appendix a small portion is left and inverted into the cecum.

[1] Technique: All specimens were put immediately into ten per cent formalin. After fixation they were sectioned grossly transversely into blocks ranging from 2 mm. to 4 mm. in thickness. Notes were made upon the condition of all the coats, and when there was any doubt as to the diagnosis, either frozen or celloidin sections were made. The total series consisted of 5,000 specimens. The first 2,000 were studied in relation to their histories in three groups: appendices removed for appendicitis alone; appendices removed in association with cholecystitis, cholelithiasis, duodenal and gastric ulcers; and those removed in association with other abdominal pathological conditions. There were 1,005 for appendicitis alone and 995 in association with other conditions, including cholecystitis, cholelithiasis, duodenal and gastric ulcer. 5,000 specimens were studied in relation to obliteration, carcinoma, diverticulum, inflammation, and foreign bodies. The material was furnished by the clinics of Drs. W. J. and C. H. Mayo, and E. S. Judd, St. Mary's Hospital, Rochester, Minnesota.

Fig. 1. (No. 31580) Section showing the glandless character of the mucosa at the point of greatest activity of the inflammatory process of obliteration.

Fig. 2. (No. 35588) Section showing the point of activity of the process of obliteration.

5. What influence does the age at the time of examination have upon the conception of the age at which the process occurs?

6. What would be about the duration of the process of obliteration if it were continuous?

7. How often does carcinoma of the appendix occur?

8. What is the relation of obliteration to carcinoma?

9. At what point in the appendix is carcinoma most common?

10. What is the clinical significance of the occurrence of carcinoma and obliteration?

11. How often may death from carcinoma of the appendix be prevented by the surgeon?

12. How often do diverticula of the appendix occur, and what is their clinical significance?

13. How often do foreign bodies occur in the appendix and what is the clinical significance?

OBLITERATION

The process of obliteration of the lumen of the appendix occurs during all ages, from five years to old age. Its activity is greatest between birth and forty years of age, and the average age at which the lumen is found to be completely obliterated is 34.6 years in appendices removed for appendicitis, and 39.1 years in appendices removed during operation for cholecystitis.

The average age at which the tip was found to be obliterated is 29.8 years in cases in which the appendices were removed for appendicitis, and 39.1 years for appendices removed during operation for gall-stones.

For appendices removed with other abdominal conditions, the average stands between these figures, the tip 32.5 years and the total lumen 37.6 years.

From those figures and the fact that the tip may be obliterated at five years of age and the total lumen completely obliterated at ten years of age, it may be seen that the process when acting rapidly extends over a

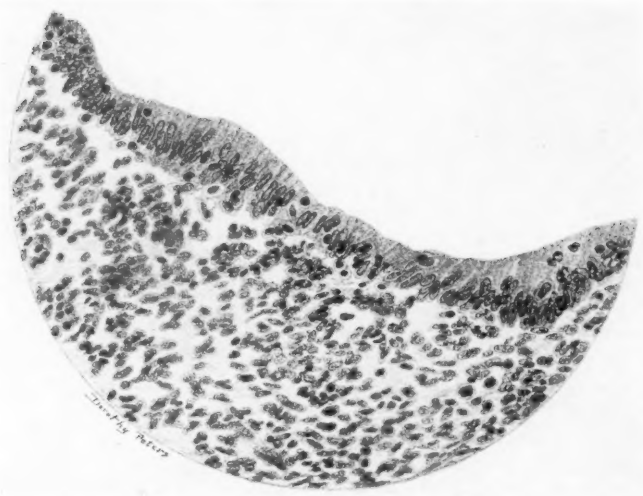

Fig. 3. (No. 35588) Epithelium covering the surface of the mucosa at the point of obliteration.

period of about five years, or at least less than ten years. (See table IX.)

We are dealing with a process therefore which may run its course in a comparatively short time and which completes its average course before forty years of age, which is exceedingly short, irregular, and early for a physiological elimination of a structure which apparently is never eliminated in man.

These results added to the fact that the point of obliteration bears definite evidence of inflammation, such as distortion of the glands, infiltration of the mucosa, submucosa, and lymph vessels with lymphocytes, plus distortion of the musculature by scar tissue, are sufficient evidence for an inflammatory process as an etiological factor rather than physiological involution. The point at which the lumen is obliterated may be completely covered by epithelium, but in such cases the epithelium is rarely thrown into folds to form definite glands.

The fact that there is an epithelial covering for the distorted mucosa is no evidence against the inflammatory process, because nature attempts to replace its lost epithelium of the alimentary canal just as it does that of the skin.

Obliteration of the lumen, partial or complete, was found to occur in 23.5 per cent of 1,005 specimens removed for appendicitis alone, and 22.8 per cent of 5,000 specimens removed for appendicitis alone and associated with other abdominal conditions which include cholecystitis 52 per cent, cholelithiasis 44.8 per cent, and duodenal ulcer 26.9 per cent.

The youngest case in which the tip of the lumen was obliterated was five years of age, and the youngest complete obliteration was ten years of age. The oldest tip obliteration was 67 years and the oldest total obliteration was 69 years.

The age at which the appendix is examined greatly modifies the conception of the time at which tip and total obliteration occur. When one examines appendices removed for appendicitis which come to operation at an average of 25.5 years, tip and total obliteration are found to be 29.8 and 34.6 years respectively. If however, one examine appendices removed during the course of operation for cholecystitis and cholelithiasis which cases come for operation at the age of 39.6 and 39.9 years, tip and total obliteration occur much later, respectively, 39.1 and 39.1 years.

Failure to realize this difference doubtless

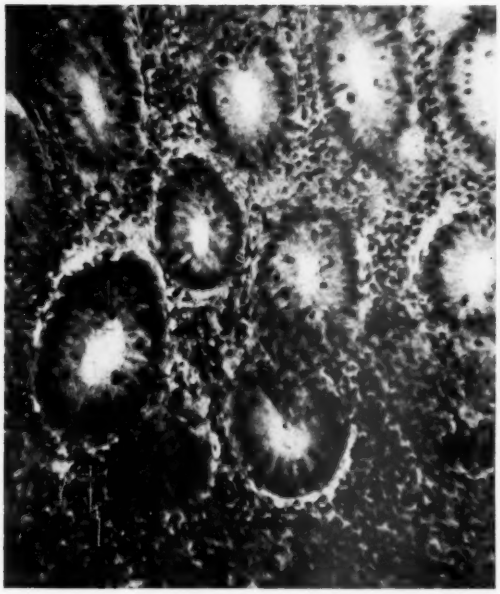

Fig. 4. (No. 19460) Showing hyperplasia and leucocytic infiltration of the epithelium at the point of obliteration.

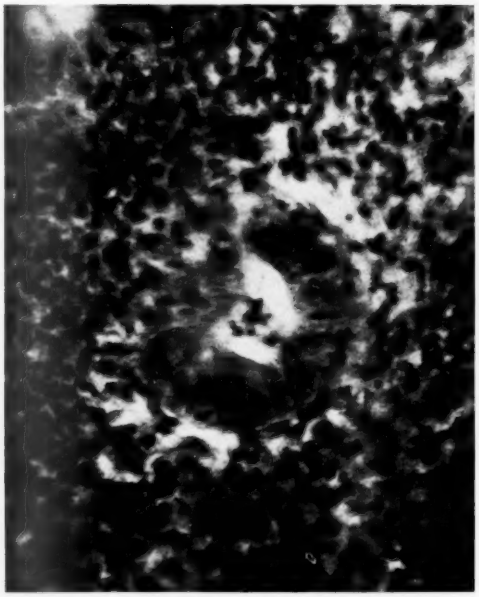

Fig. 5. (No. 23188) The remnant of a gland in an inflammatory mucosa.

was responsible for the percentages found at autopsy by Ribbert, Aschoff, and others who apparently considered the process complete at the time of death, rather than the possibility of it having been complete years before death even at ten years of age.

The following tables consisting of statistics gathered from our cases, and where noted from other sources, graphically represent the facts as they are found.

The duration of the process of obliteration is not only interesting but important in refuting the normal involution idea of the process.

I. OBLITERATION OCCURRING IN DECADES

	Partial and Complete Obliteration			Partial Obliteration
	Ribbert	Aschoff	MacCarty	MacCarty
1–10 years	4%	6%	0%	11%
10–20 years	11%	12%	3%	17%
20–30 years	17%	20.3%	8%	16%
30–40 years	25%	28%	15%	22%
40–50 years	27%	42%	16%	17%
50–60 years	36%	14%	17%	21%
60–70 years	53%	....	50%	50%
70–80 years	58%	....	0%	0%

II. RELATION OF AMOUNT OF OBLITERATION TO THE AGE IN APPENDICITIS

Amount	Average Age at Operation	Average Duration of Symptoms
Tip	29.8 years	
$\frac{1}{3}$ and $\frac{1}{4}$	27.5 years	5.2 years
$\frac{1}{3}$	29.1 years	3.4 years
$\frac{1}{2}$	29.7 years	3.6 years
$\frac{2}{3}$	32.8 years	8.1 years
Partial	27.1 years	4.0 years
Average age of complete obliteration	34.6 years	4.0 years

III. AVERAGE AGE WITH OBLITERATION IN CASES OF APPENDICITIS

Earliest tip obliteration	5 years
Earliest total obliteration	10 years
Latest tip obliteration	67 years
Latest total obliteration	61 years
Average age of complete obliteration	34.6 years
Average age of tip obliteration	29.8 years

IV. AVERAGE AGE OF OBLITERATION IN THE APPENDIX ASSOCIATED WITH GALL-STONES AND CHOLECYSTITIS

Earliest tip obliteration	14 years
Earliest total obliteration	17 years
Latest tip obliteration	64 years
Latest total obliteration	69 years
Average age of complete obliteration	39.1 years
Average age of tip obliteration	39.1 years

V. AVERAGE AGE OF OBLITERATION IN THE APPENDIX ASSOCIATED WITH OTHER ABDOMINAL CONDITIONS

Earliest tip obliteration	20 years
Earliest total obliteration	23 years
Latest tip obliteration	50 years
Latest total obliteration	64 years
Average age of complete obliteration	37.6 years
Average age of tip obliteration	32.5 years

VI. SEX

Of all cases of appendicitis 55.5% were males, and 44.5 % females. Of these, the cases showing $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, and $\frac{2}{3}$ obliteration, 44.8% were males and 55.2% females.

VII. OCCURRENCE OF OBLITERATION OF THE LUMEN OF THE APPENDIX

Autopsy (2,549 cases) (howiki)	17 %
Operation for appendicitis (1,005 cases)	23.5%
All cases examined (5,000)	22.8%

VIII. SUMMARY OF TABLES III, IV, AND V

Earliest tip obliteration at age of	5 years
Earliest total obliteration at age of	10 years
Latest tip obliteration at age of	67 years
Latest total obliteration at age of	69 years
Average age of tip obliteration (appendicitis)	29.8 years
Average age of total obliteration (appendicitis)	34.6 years
Average age at operation of appendicitis	25.5 years
Average age at operation for cholecystitis and cholelithiasis plus stones	39 years
Average age of total and tip obliteration in cases with cholecystitis and cholelithiasis plus stones	39 years

IX. DURATION OF THE ACTIVITY OF THE PROCESS OF OBLITERATION

				Appendices Asso. with Cholecystitis	Other Abdominal Conditions
Youngest total, 10 years	Eldest total, 69 years	Average total, 34.6 years		39.1	37.6
Youngest tip, 5 years	Eldest tip, 67 years	Average tip, 29.8 years		39.1	32.5
Length of Process 5 years	Length of Process 2 years	Length of Process 4.8 years	L. of P. 00.0	L. of P. 5.1	

CARCINOMA

Carcinoma of the appendix occurred 22 times ($\frac{44}{1000}$%) in 5,000 specimens.

First 1,000 specimens	5 or .½ %
Second 1,000 specimens	7 or .$\frac{7}{10}$ %
Third 1,000 specimens	3 or .$\frac{3}{10}$ %
Fourth 1,000 specimens	2 or .$\frac{1}{5}$ %
Fifth 1,000 specimens	5 or .½ %

Seventeen of these were not extensive enough to be seen on the serosa nor to cause any enlargement, thereby making the diagnosis by the surgeon impossible. In one of the seventeen cases the growth had made its way through to the serosa and was visible as a small orange colored speck about one-half millimeter in diameter. This upon gross external examination was thought to be fat in the subserosa. Microscopic examination revealed it to be carcinoma which had reached this point through the lymphatics. Upon gross examination of formalin fixed specimens the neoplasms in this series were orange colored masses occupying all or a part of the submucosa and mucosa and not usually extending beyond the submucosa. The growth itself on gross section appeared as a homogeneous or finely granular mass occupying the center of the block, involving all the coats excepting the muscularis, subserosa, and serosa. The color was very characteristic in specimens preserved in formalin. (See plate.) In all cases there was the same orange. This is very important in distinguishing the neoplasms grossly from lemon-yellow fat, which occurs in the submucosa and subserosa, especially in chronically inflamed or obliterated specimens.

Microscopically the growth consisted of alveoli filled with epithelial cells, the nuclei of which were in general oval or round and presented fewer irregularities than one usually sees in carcinoma in other portions of the alimentary canal. The size and lack of marked irregularity on the part of the nuclei as well as the alveolar arrangement and staining quality have been the cause of some observers calling the neoplasms endotheliomata and basal-cell carcinomata.

The microscopic picture of the epithelial cells of the mucosa if studied in the normal appendix, the chronically inflamed appendix, and in the partially obliterated appendix, is one of simple hyperplasia. In the normal and in the early chronically inflamed mucosæ the reaction consists of hyperactivity and many goblet cells may be seen. As the process becomes more chronic the picture changes from hyperactivity to an hyperplasia which seems rather to be an overproduction than over function. The nuclei of the cells become larger in proportion to the amount of protoplasm. They take the stain less densely. In early carcinoma the cells vary in overproduction, size, and shape of the nuclei. The

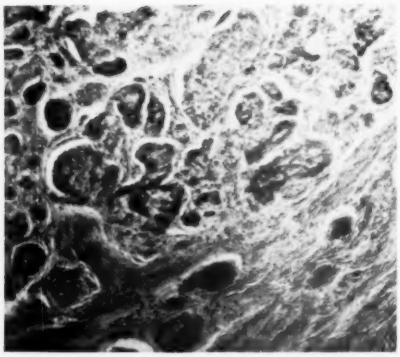

Fig. 6. (No. 31326) Carcinomatous islands in carcinoma of the appendix.

nuclei still resemble the nuclei of the remaining glands of the mucosa, and can be traced to them rather than to the endothelium of the lymph and blood-vessels. As the growth becomes advanced and extends through the lymph spaces the nuclei become more irregular and their identity becomes less certain, although in such advanced condition such qualities as irregularity of size and shape of the nuclei, staining properties, invasion of lymph vessels, musculature, and peritoneum, as well as the definite descent from the glandular epithelium of the mucosa, may be seen.

At no time during the early growth do these cells resemble the epithelium of other portions of the alimentary tract, and in no case of this series was the growth far enough advanced to produce metastases, although metastases have been reported by other observers. (Nowicki.)

The youngest case occurred with acute appendicitis in a girl 5 years of age, and the oldest was found accidentally at autopsy upon a patient 80 years of age, who died after an operation for the removal of a stone from the urinary bladder. The same patient had a duodenal ulcer and cholecystitis. The next oldest case was a female, age 50 years. The average age of all cases was 30 years, and the average duration of symptoms was 3.3 years. Thirty-one per cent were found in appendices removed in association with other abdominal conditions. They occurred in 1.9 per cent or once in every 53 partially or totally obliterated appendices. Seventy-three per cent occurred in females.

The fact that 90 per cent of the carcinomata occurred in the tip of the appendix and in partially or completely obliterated appendices is very important. One may practically conclude, in view of our experience with carcinoma in other regions, that it occurs here in association with a chronic inflammatory process, since it is seen more frequently at the tip, which is the point of activity in the process of obliteration — inflammatory process.

While studying these cases the question arose: How often does carcinoma of the cecum occur secondarily to carcinoma of the appendix? This is indeed difficult if not impossible to determine.

In 20 specimens of carcinoma of the cecum, which were examined by the writers, only one might have arisen from the appendix. In this case the growth was very extensive and its origin was doubtful. The fact that such a large percentage of the carcinomata arises at or near the tip speaks also against the frequent secondary involvement of the cecum.

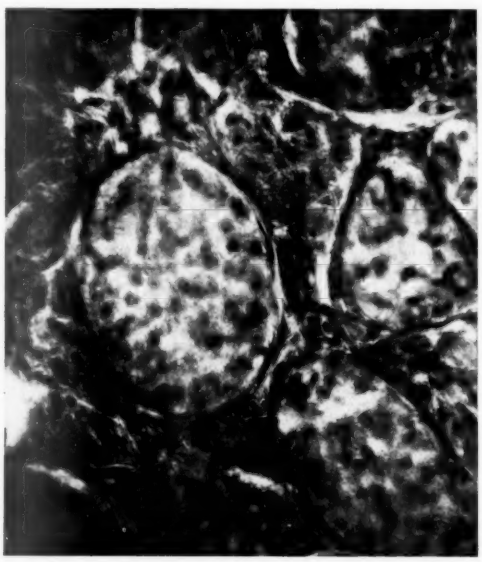

Fig. 7. (No. 24497) Alveolar arrangement of the perverted cells in carcinoma.

The clinical significance of the occurrence of carcinoma of the appendix, as found in this series, may be summed up by saying that surgeons remove carcinomatous appendices, without suspecting malignancy, and the pathologist is also very apt to overlook them if the appendix is not opened and sectioned.

The occurrence of 90 per cent of the neoplasms in appendices, the lumena of which are being or have been obliterated, and the fact that carcinoma occurs in one of every 53 partially or completely obliterated appendices, demand the removal of such appendices instead of leaving them, because we think that nature is taking care of the process, or that the process is a normal physiological involution.

According to this series the surgeon may save one in every 225 cases from carcinoma of the appendix by removal of that structure when such removal is possible.

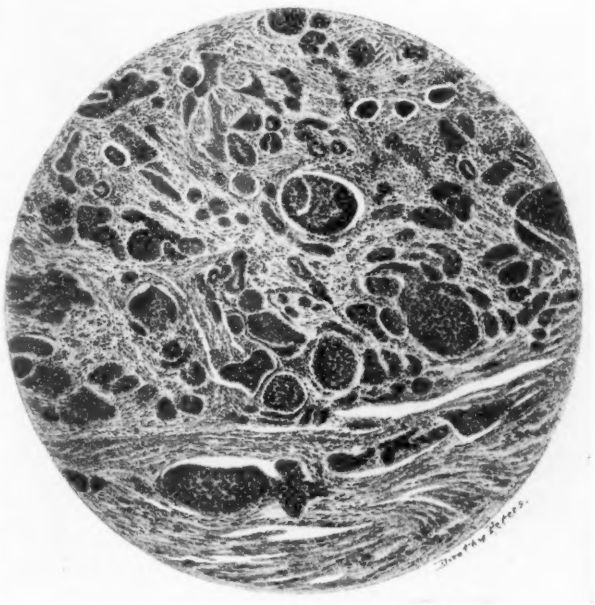

Fig. 8. (No. 31005) Involvement of the submucosa and the musculature by carcinoma.

X. CARCINOMA

5 carcinoma in 1st 1,000 specimens	$\frac{1}{2}$%
7 carcinoma in 2d 1,000 specimens	$\frac{7}{10}$%
3 carcinoma in 3d 1,000 specimens	$\frac{3}{10}$%
2 carcinoma in 4th 1,000 specimens	$\frac{1}{5}$%
5 carcinoma in 5th 1,000 specimens	$\frac{1}{2}$%
22 carcinoma in 5,000 specimens	$\frac{44}{100}$%

77% were not diagnosed from their gross external appearance.
Youngest, 5 years old (female, death from acute appendicitis).
Eldest, 80 years old (male, death after removal of stones in the urinary bladder.)
73% were females.
90% occurred in partially or completely obliterated appendices.
90% occurred at the tip of the appendix.
Average age 30 years.
Average duration of symptoms, 3.3 years.
1 in every 53 partially or completely obliterated appendices was carcinomatous.
1 in every 225 of all appendices in this series was carcinoma.
31% were found in association with other abdominal and pelvic conditions.
.6% of the carcinomatous appendices were removed in association with other conditions.

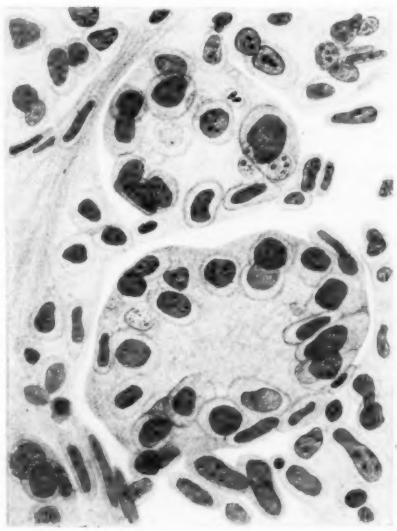

Fig. 9. (No. 31005) Showing the irregular character of the nuclei in early carcinoma of the appendix.

HISTORIES OF THE CASES OF CARCINOMA

Hospital No.	Age	Sex	Duration of Symptoms	Location of pain	Fever	Vomiting	Jaundice	Condition Found
28043	26	F.	4 yrs.	Rt. iliac region	+			Chronic appendicitis
28359	50	F.	15 yrs.	Umbilical region Rt. iliac region				Chronic appendicitis. Tumor on the end of the appendix. Carcinoma
26527	25	F.	4 yrs. 3 yrs.	Epigastrium Rt. iliac region				Chronic cystic appendix
18030	33	M.	2 yrs.	Abdomen (gen.) Rt. iliac region	+	+		Cirrhosis of liver. Carcinoma at base of appendix
17259	20	F.	Several years	Rt. iliac region				Subacute appendicitis. Carcinoma of tip of appendix
31005	23	F.	8 yrs.	Rt. iliac region to back				Chronic appendicitis
25862	30	M.	1 yr.	Abdomen (gen.) Rt. iliac region	+	+		Chronic appendicitis
31023	37	F.	4 yrs.	Umbilical region Rt. iliac region	+	+		Chronic appendicitis. Gall-bladder thickened
31326	26	F.	8 yrs.	Rt. hypochon. Rt. iliac region	+	+		Chronic appendicitis
31679	5	F.	Since birth			+		Chronic appendicitis. Enlarged glands in mesentery
32898	22	F.	8 mos.	Rt. iliac region	+	+		Chronic appendicitis
29613	27	F.	7 wks.	Rt. iliac region Rt. hypochon.			+	Chronic appendicitis (adherent)
24497	42	M.	3 mos.	Epigastrium				Rt. inguinal hernia. Chronic appendicitis
34532	80	M.	10 yrs.					Four stones in urinary bladder
33079 office		F.						Subacute appendicitis. Cholelithiasis
32682	34	F.	4 mos.	Rt. iliac region		+		Endometritis and uterine fibroids. Appendicitis. Carcinoma of tip of appendix
31580	16	F.	2 yrs. 10 days	Rt. iliac region Rt. iliac region	+			Acute appendicitis
21362	29	M.	11 yrs. 1 mo.	Rt. iliac region Rt. iliac region	+	+		Acute appendicitis. Small abscess in omentum
23043	26	F.	2 yrs.	Rt. hypochon.		+	+	
*Carc	A							
*Carc	B							
*Carc	C							

*Labels blurred or lost.

HISTORIES OF CASES OF DIVERTICULUM

Hospital No.	Age	Sex	Duration of Symptoms	Location of Pain	Fever	Vomiting	Jaundice	Condition Found
22429	53	M.	10 yrs.	Rt. iliac region Umbilical region				Acute appendicitis
22170	40	M.	10 yrs.	Gen. abdomen Rt. iliac region				Acute appendicitis
34981	28	M.						Abscess in region of kidney
34878	26	F.						Acute appendicitis
24191	40	M.	8 yrs. later 2 mos.	Rt. iliac region		+		Chronic appendicitis
26098	64	F.	30 yrs.	Epigastrium		+		Cystic appendix. Cholelithiasis
21793	27	F.	1 yr.	Rt. iliac region				Acute appendicitis
21761	38	F.	7 mos.	Rt. iliac fossa	+	+		Acute appendicitis (Abscess)
20140	56	M.	5 yrs.	Rt. lumbar Gen. abdomen	+	+		Acute appendicitis (Abscess)
19777	36	M.						Chronic appendicitis
Case A				Label was lost				
25436	18	M.	1 yr.	Gen. abdomen Rt. iliac region	+	+		Acute appendicitis. Small abscess
28853	27	M.	5 yrs.	Rt. iliac region		+		Chronic appendicitis
31277	24	F.	5 yrs. 2 mos.	Rt. iliac region	+	+		Subacute appendicitis
25623	44	F.	8 yrs. 5 yrs.	Rt. hypochon. Rt. iliac region	+			Subacute appendicitis. Cholelithiasis
30982	27	M.		Epigastrium				Subacute appendicitis
21809	30	F.	6 mos. 2 wks.	Abdomen Abdomen	+ +	+		Acute appendicitis. Tip adherent to small bowel

XI. DIVERTICULUM OF THE APPENDIX

17 cases in 5,000 specimens.
They were usually multiple.
56% occurred in acute appendicitis.
Youngest, 18 years.
Eldest, 64 years.
Average age at operation, 34 years.
Average duration of symptoms, 7 years.

XII. STONES AND OTHER FOREIGN BODIES

57 specimens of 5,000 contained fecoliths, fruitseeds, hairs, toothbrush bristles, birdshot, pins, or gall-stones.

DIVERTICULUM

Diverticulum of the appendix occurred, usually as a multiple condition, in 17 cases. The diverticula were grossly visible but varied greatly in size, the largest in the series being about one-half centimeter in diameter and projecting beyond the surface about one-half centimeter. They were covered by serosa and varied in color according to their contents. They consisted of evaginations of the submucosa, muscularis mucosæ, and mucosa through an opening in the muscular coats. The edges of this opening were rounded off and permited the tissues of the submucosa, which fused with the subserosa, to pass around

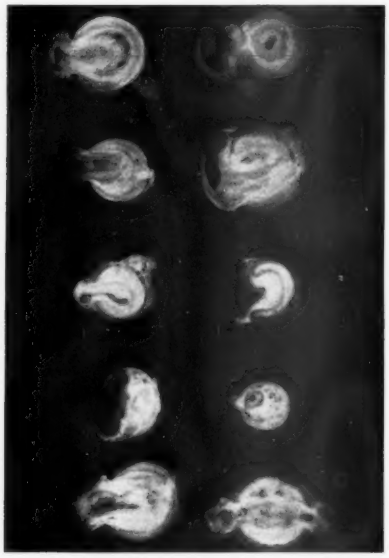

Fig. 10. (Nos. 35436, 34981, 28853, 25623, 30921, 30982, 21793, 31277, 21761, 29669) Photographs of gross blocks taken through specimens of diverticula of the appendix.

it in a well defined manner. The wall of a diverticulum consists only of the mucosa, muscularis mucosæ, submucosa, subserosa, and serosa. These coats are thinner than normal.

The condition was found in a wide range of ages, the eldest 64 years and the youngest 18 years.

Fifty-six per cent of the cases occurred in acute appendicitis. Fifty-six occurred in females. The only cases that were found in association with other conditions were removed with gall-stones. There were two such cases. In one of these the appendicitis was subacute, the other acute. The average duration of the symptoms was seven years and the average age at operation is 34 years. Two complained of pain in the epigastrium and one in the right hypochondrium. The condition does not seem to bring about symptoms so early in life as the appendix ordinarily does, but a higher percentage occurs in acute appendicitis.

CONCLUSIONS

1. This series confirms the percentage of obliteration found in the appendix by other observers.

2. Obliteration seems to occur as the result of an inflammatory process as shown by its histology, the time of occurrence, its irregularity of occurrence, the duration of the process, and the higher frequency in appendicitis than at autopsy in general.

3. Many appendices become acutely inflamed during the process of obliteration and therefore an obliterated appendix should be removed if possible.

4. Carcinoma may occur at practically any age.

5. It was impossible to make the diagnosis of carcinoma from the external appearance in 77 per cent of the cases of carcinoma.

6. The high frequency of carcinoma in obliterated or partially obliterated appendices may demand removal of all partially or completely obliterated appendices.

7. Carcinoma of the appendix occurs in association with changes in the appendix which are related to the process of obliteration.

8. Carcinoma of the cecum probably arises from the appendix only in a very small percentage of the cases.

Fig. 11. (No. 31277) Section showing the coats and character of a diverticulum of the appendix.

DISTENSION CHANGES IN THE DUODENUM IN CHRONIC INTESTINAL STASIS

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I HAVE for a long time been familiar with and have described in several papers the conditions of distension of the small intestine and of the duodenum in intestinal stasis, and especially in that form in which there is definite obstruction of the ileum at its termination usually by a mesentery or band which develops in the mesentery, or less frequently by an appendix so anchored as to hang up and obstruct the end of the ileum, or merely by an obstruction of the lumen of the end of the ileum as it passes over the pelvic brim by the weight of the loaded ileum occupying the true pelvis and obtaining a purchase on the bowel as it emerges from that cavity. This obstruction can be readily demonstrated by the use of bismuth. In these conditions I had observed both before the operation that the duodenum was abnormally sensitive and at the time of the operation that the duodenum was unusually distended.

For some time I attributed the distension of the duodenum to the damming back of the contents of the ileum by the obstruction of its termination, though it was clear that it could only be an indirect or reflex effect, since the jejunum apparently emptied with much rapidity. Later I was led to conclude that the distension of the duodenum was secondary to a compression or obstruction of the third part of the duodenum by the strain exerted upon it by the mesentery of the small intestine, or by the pull on it by the jejunum. Still I was unable to obtain objective evidence which would be sufficiently clear to convince others, though the symptoms complained of by the patient, the X-ray conditions, and the appearance presented by the duodenum at the time of the operation seemed to me to demonstrate this.

The distension of the duodenum has not infrequently associated with it a duodenal

24 hours

After bismuth meal 26 hours

Fig. 2.

ulcer. Indeed the symptoms of duodenal ulcer are very similar to those of obstruction of the duodenal outlet. This similarity causes much confusion to surgeons who only too readily attribute these symptoms to the usually anchored appendix and so attach to it a degree of responsibility and blame which it does not deserve. Though distension of the duodenum and ulceration of the duodenum are found associated with obstruction of the end of the ileum they may not be necessarily dependent on it, any more than they are due to the kinking of the appendix and those other conditions which are effects of a general intestinal stasis. At the same time it is clear that the raising of the level of infection by organisms of the contents of the small intestine in consequence of the ileal obstruction is very liable to infect a duodenum whose contents collect and stagnate to an abnormal extent.

Fig. 1 illustrates the state of the small

Fig. 3. Represents the ileal loops full of bismuth emulsion, a small portion only having passed into the cecum. The circular dark area represents the shadow cast by a coin placed on the umbilicus.

intestine resulting from a marked ileal kink in a case of duodenal ulcer whose symptoms disappeared after I had performed a gastroenterostomy and divided the band obstructing the ileum. The radiogram was taken twenty-four hours after the administration of bismuth.

Fig. 2 shows a radiogram of a case of ileal obstruction taken eight hours after the administration of bismuth. The distension of the ileum by bismuth remained for a long time. In this case the kinking was very marked and the ileum and the duodenum showed very distinct distension changes. The patient had been sent into the hospital as a case of duodenal ulcer with a view to the performance of a gastroenterostomy. Beyond being dilated the duodenum showed no other change.

Fig. 3 shows the condition of the ileum in a case of ileal kink sixteen hours after the administration of bismuth. The obstructions at the ileocecal juncture had progressed in severity till as on the occasion on which this photograph was taken the patient was suffering from acute obstruction and his life was in peril. His symptoms had simulated those of duodenal ulcer for a considerable period, and these were followed by distinct clinical evidence of intestinal obstruction which clearly arose in consequence of an ileal kink. I might multiply indefinitely the

Fig. 4. Vertical.

Fig. 5. On couch.

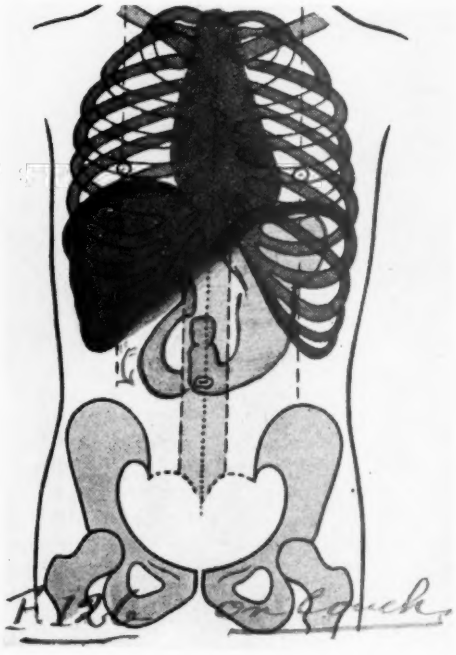

Fig. 6.

radiograms illustrating this condition, but those produced are sufficient for my purpose.

There came under my care quite recently a girl aged nineteen years who had suffered very severely from chronic intestinal stasis for five years. She was very wasted, weighing only seventy-two pounds. She had no appetite whatever, suffered great pain after food, chiefly in the duodenum and in the end of the ileum. She had been sent home to England in order that a gastroenterostomy should be performed, as stenosis of the pyloric orifice was suspected. I cannot describe her condition better than by quoting the report of Dr. Alfred C. Jordan, who examined her after the administration of three ounces of carbonate of bismuth in the form of an emulsion. The radiograms, especially of the duodenum, are of the greatest importance and illustrate exactly the condition to which I wish to call attention, and as the obstruction is very marked in this case the photograph affords obvious undeniable and incontrovertible evidence of the difficulty of evacuation of the duodenal contents.

Fig. 7. Stomach and ileum after 4 hours.

Fig. 8. After 27 hours.

Fig. 9. After 33 hours. Finger in rectum.

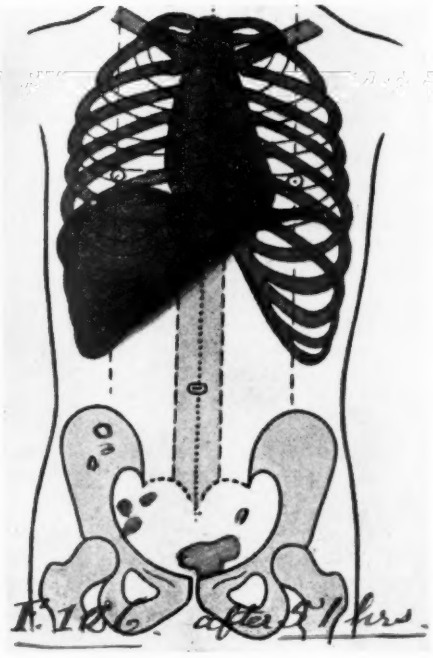

Fig. 10.

December 17, 1910.

Dear Mr. Lane:

Miss C. M., 19. (F. 126.)

The examination of the chest showed nothing abnormal.

The diaphragm moves poorly on both sides.

The bismuth emulsion was introduced through a stomach tube, and the stomach was seen to be dilated and greatly dropped, the great curvature lying on the brim of the pelvis.

On the couch the dilated stomach was well shown, a considerable portion of it being to the right of the middle line. Gastric peristalsis was active, the waves advancing normally to the pylorus, whose behavior was seen to be perfectly normal. The bismuth began to enter the duodenum at once, but on reaching the third part of the duodenum it advanced no further, and repeated powerful contractions of the duodenum took place in the endeavor to forward the contents into the jejunum. The attempts were seen to be ineffective, and were accompanied by great pain. (Figs 5 and 6).

One hour later some of the bismuth was seen scattered through the ileum, but by far the greater part was still in the stomach. The pylorus was seen to be normal, while the duodenum was contracting violently but uselessly to expel its contents.

After 4 hours a similar condition still obtained, though a good deal of bismuth was now scattered through the ileum and a fair amount had reached the lower end of the ileum. (Fig. 7).

At the end of 9 hours there was still some bismuth in the stomach, and the appearances of the stomach and duodenum were as before. There was a mass of bismuth in the lower end of the ileum; none in the cecum or beyond. During the examinations 4 and 9 hours after the bismuth meal, the duodenal obstruction was seen to relax occasionally and allow the contents to proceed.

After 27 and 33 hours the stomach and duodenum were empty. There was some bismuth in the cecum and ascending colon, but the greater part was dried up in the end of the ileum, for your own rectal examination showed the rectum to be empty.

At the end of 51 hours (after an enema which was returned at once with a good deal of bismuth in it) there was some bismuth (about one-third of the original amount) in the rectum. There were traces in the cecum. Powerful contractions of the duodenum could be seen to be taking place, although it contained nothing more opaque than Benger's food. (Figs. 8 and 9.)

It is clear that there is an acute obstruction in the third part of the duodenum. This may be organic, but appears to be in part spasmodic, for it yields from time to time. There is also great delay at the lower end of the ileum, and this would appear to be probably due to organic obstruction also, though it might be merely due to inertia. There is no reason to suspect any abnormality of the large intestine. I am, yours very truly,

ALFRED C. JORDAN, M. D.

The very important questions that arise in connection with this communication are:

First, does a condition of distension of the duodenum by a stagnation of its contents resulting from obstruction to its drainage, a part of a sequence which I call chronic intestinal stasis, tend to bring about inflammatory changes in the mucous membrane of the upper part of the duodenum which produce clinical symptoms of a similar character and of varying severity? Is the so-called hunger pain the result of this distension of the duodenum, and does the entry of food into the stomach produce a forcible refflex evacuation of the obstructed duodenal contents and so a relief ot the pain?

Second, are the contents of the duodenum very liable to infection by micro-organisms whose level in the drainage scheme has become abnormally high in chronic intestinal stasis, and does the presence of micro-organisms in the duodenal contents assist materially in the development of inflammatory changes in its mucous lining?

Third, how far does a gastroenterostomy facilitate the evacuation of the duodenal contents by the fact that in this operation, however it is performed, the commencement of the jejunum is secured in such a position as to take strain off the duodeno-jejunal junction and so obviate any kinking at this point.

Fourth, does the presence of a communication between the stomach and jejunum play any part in the cure of the inflammatory changes in the mucous membrane of the duodenum? The question of mechanical obstruction by cicatrization is not now under consideration here.

Fifth, what part does the lowering of resistance to the entry of micro-organisms due to autointoxication play in this sequence?

Personally I have very little doubt as to what are the answers to these questions, more particularly in view of the information provided by the case of Miss M., which is merely a caricature of the clinical conditions with which we are all very familiar.

Unfortunately, observers too readily lose themselves in detail, and the tendency of specialization is to lose common-sense in proportion as a special sense is cultivated,

the most common result of which being that one conspicuous effect is only too readily regarded as the cause of another less obvious one.

The conditions found at the operation on this patient were precisely those expected, viz., that a vertical pull upon the commencement of the jejunum resulted in such a torsion of its commencement at the junction of the duodenum as to render evacuation of the contents of the tube very difficult. This condition of torsion I have observed on many occasions. The jejunum was connected with the posterior surface of the stomach by a gastroenterostomy in such a way as to render any torsion of the jejunum at its commencement by its own weight as little likely as possible. The obstruction of the end of the ileum was purely static and was due to the resistance afforded by the brim of the pelvis, the cecum having been fixed by adhesions in the iliac fossa. The appendix was normal.

INTESTINAL OBSTRUCTION DUE TO KINKS AND ADHESIONS OF THE TERMINAL ILEUM[1]

By CHARLES H. MAYO, M. D., Rochester, Minnesota

IN addition to the list of reflex symptoms originating from the appendix, there are certain symptoms caused by partial obstruction of the lower ileum which somewhat resemble those of the stomach or intestine, but they are less severe and more chronic in character. We are all familiar with the marked stomach reflex in obstruction of the small intestine, and experiments have shown how readily in this condition the small intestine reverses its peristalsis. We are also familiar with the marked reflex (though to a less degree) of the stomach in cases of cystic appendicitis and moving concretions of the appendix. It is quite apparent that the stomach is the center of effect from many reflex sources of both the conscious and subconscious nervous system. To such an extent is this true that approximately only one individual in ten who complains of apparent serious stomach trouble ever has any real lesion of this organ.

In its development the mid-intestine consists of all the small intestine below the common duct and includes the cecum and appendix as well as the ascending and part of the transverse colon. About ten inches of the ileum is pelvic and originally it is fixed to the lower end of the cecum. This attachment, which is in addition to the opening into the cecum by lateral union, should, and usually does, become detached about the period of birth, when it does not, we have additional cause for obstruction. The ileum may have a comparatively short mesentery at its termination above the pelvic brim, and at times the cecum has a true mesentery permitting a considerable range of motion.

For a number of years past, in dealing with intestinal stasis believed to be due to a diseased condition of the appendix, in which the seriousness yet obscurity of the symptoms required a larger incision for exploration than was usually made for the removal of the appendix when it was unmistakably diseased, and the symptoms more definite, we have, at times noted a definite kink of the ileum within three inches of the ileocecal valve. However, the frequency with which the condition was seen in certain cases did not occur to us until a few years ago when our attention was personally called to it by Arbuthnot Lane (1).

Arbuthnot Lane has undoubtedly had a most extensive experience in the surgical treatment of serious chronic constipation, and he believes that the adhesions found in the kink of the ileum and in the appendix have added to the obstruction and tended to

[1] Read before the Western Surgical Association, December 20, 1910.

Fig. 1. A form of Lane kink with adhesions.

the development of appendical concretions from retained fecal contents in the organ. He also believes that the condition is not necessarily inflammatory but is the natural result of the tendency of the heavily loaded fluid contents of the cecum to descend to the pelvis owing to the erect position of man, and therefore, the bands are developed in the lines of traction force. There is found a short and firm attachment of the lower ileum, and an attached or short appendix with ptosis of the cecum. The ileum is rolled over and becomes adherent to the peritoneum beneath it.

Two years ago Jackson (2) reported certain cases of appendicitis showing, at operation, a veil of new-formed peritoneum over the cecum and ascending colon. Jackson claimed that where this veil existed the patients were not often cured by the removal of the appendix but that they could be cured by the removal or partial removal of this adventitious peritoneum. We believe that this condition is undoubtedly due to the late rotation of the bowel and descent of the cecum from its hepatic position after the formation of the parietal portion of the peritoneal cavity in the infant. The cecum burrows its way into position, as it were, through the peritoneum. Such cases, however, are often found to show the bands of adhesions and narrowing of the ileum.

During the past two years we have observed many cases in which there was a definite kink of the ileum within a few inches of its termination. The ileum was rolled over and fixed upon the mesentery, evidently a condition of inflammatory origin. Sometimes these adhesions with resulting bands of peritoneum causing a kink, appear to be a congenital development because the condition has been reported existing in children without evidence of local inflammatory cause. It has been observed that when adhesions were present, or the peritoneal bands were greatly thickened, the appendix also showed chronic inflammation which was apparently the source of the peritoneal thickening. The relief afforded by freeing the bowel of the adhesions indicates that this is undoubtedly a condition which has much to do with the ill health of the individual, even though the greater number of symptoms were not local but reflex in character, acting upon the stomach and intestines.

With the development of technique in surgery the risks of operation have gradually been eliminated and considerations other

Fig. 2. Lane kink after separation of the band and removal of the appendix.

than that of mortality have become of marked importance, viz., morbidity and permanent cure. Some twenty years ago surgery of the appendix was confined to the treatment of grave and tangible lesions, such as draining abscesses. A little later on the appendix was searched for and removed during operation for abscess, and still later the "interval" operation was developed which not only prevented serious infection but relieved these patients of the minor symptoms associated with a chronic catarrhal appendix. Operations upon the appendix became fixed within narrow limits; they were made through the smallest possible opening in the shortest possible time, with the least possible exposure of the intestine, and with no examination of organs other than the appendix. In rare instances the patient's failure to recover might later show that he had gall-stones, ureteral calculæ, or even sacroiliac disease in addition to the diseased appendix.

To-day the refinements of surgical methods demand a more careful examination of the abdomen in a larger percentage of operated cases, especially in those individuals who do not present well marked clinical symptoms of the disease which is suspected. The object of this brief paper is the earnest recommendation that the terminal four inches of the ileum be examined in all cases where it is convenient to do so when the abdomen is open, and especially should this be done when the condition of the appendix at operation (seen through a small incision) does not show sufficient change to account for the serious symptoms which demanded operative procedures.

It is not always possible to differentiate, clinically, the symptoms under consideration from those caused by disease of the appendix, as the conditions are so often associated. The region of the kink is usually tender, extending from the umbilicus downward to the right, while localized pain may also be

Fig. 3. Form of narrowing of the ileum in kink (Lane).

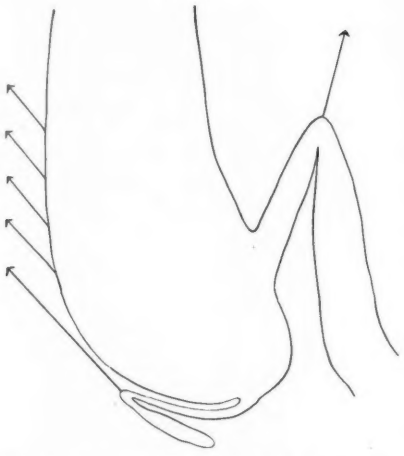

Fig. 4. Lines of traction with weight in cecum (Lane).

obtained. The pain is increased by peristaltic activity, especially when caused by the activity of the individual. The intestinal and gastric symptoms are often more marked at fairly regular periods after eating, and frequently there is a distension of the small intestine in evidence when the individual is fatigued. In some of these cases with the symptoms as outlined above, there is chronic constipation and also alternating constipation and colitis.

In the treatment it is essential to cut all confining bands, and prevent the formation of adhesions by adjusting the peritoneum with sutures. In some cases the application of sterile vaselin over the traumaticized peritoneal area, seems to prevent the development of deleterious adhesions following the operation.

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TERATOMA TESTIS AND ITS DERIVATIVES

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IN 1696 Saint Donat described a complex tumor of the testicle in which he recognized the bones of a rudimentary skull and two pigmented depressions which he interpreted as the embryonic eyes of a parasitic fœtus. More than a century later Prochaska, 1803, recognized portions of a fœtus in two similar tumors. In 1833 Andrè de Perrone found hair and teeth in the cystic portions and bones in the solid parts of a testicular tumor, while Velpeau, 1841, described joint formations, skull, vertebræ, hair, rudimentary eyes, intestinal canal, and fat and muscle tissue.

The tridermal composition of these tumors was first recognized by Johnson, the ectoderm being represented by cysts lined by flat epithelial cells, the entoderm by cysts lined by columnar and ciliated epithelium and the mesoderm by bone and connective tissue.

In a congenital case, Verneuil, 1855, identified brain tissue, nerve fibers, ganglion

cells, optic cups, intestinal or bladder structures, pia mater, smooth muscle, and cartilage. Billroth observed carcinomatous peritoneal metastases from a complex tumor. Paget, 1855, described a cystic tumor of the testicle chiefly cartilaginous, with numerous small chondromata along the vas deferens, and many nodular chondromata in the lungs. Senftleben, 1858, seems to have first described striated muscle in these tumors. Koslowski, 1897, found cardiac muscle arranged about cavities resembling the four chambers of the heart. Adult or embryonal blood-vessels are constantly present. In the bones red marrow may appear, and Cavazanni found nucleated red blood cells. Waldeyer, 1868, found sarcomatous areas in his case and described the invasion of large veins by polypoid masses of sarcoma. Wettergren, 1872, found adenomatous, carcinomatous, and sarcomatous areas in several tumors which were largely cystic, in one of which occurred metastases in heart, lungs, and peritoneum.

Many authors connected the islands of cartilage with a rudimentary trachea, others identified sweat and sebaceous glands in the skin. Dürr described an area resembling fibroadenoma mammæ, and Kocher and Wilms recognized cranial and sympathetic ganglia. Kockel described formed portions of the central nervous system, with ganglia, ventricles, and choroid plexuses. An abundance of lymphoid tissue with occasional lymph follicles was noted by many authors, while the liver metastases in Westenhofer's case had the structure of lymphosarcoma. Chevassu and Piquè thought they could identify liver cells and cords in their cases. Schlagenhaufer, Pepère, and Gessner detected in certain areas in their cases a resemblance to embryonal lung tissue. Chevassu pictures very characteristic renal tissue in a case reported by Pepère. Gessner described a rudimentary ovary. Ohkubo detected an imperfect crystalline lens, salivary glands, breast tissue, spleen, and adrenal. In the writer's case, No. 18, a structure resembling a uterus was found, along with three lobes of adult thyroid gland. Thus, not only has the tridermal nature of these tumors been demonstrated, but portions of many complex organs have been found so often as to leave no doubt that the complex testicular tumors represent an abortive attempt at the production of a parasitic fœtus.

While many interesting details regarding testicular tumors were contributed by very numerous writers, definite steps in the progress of this knowledge were marked by the publication of several noteworthy monographs. The gross anatomy of teratoma testis was described under the term hydatid disease, and elaborately illustrated in 1845 by Astley Cooper. Curling in 1853 divided the growths into cystic, relatively benign, and solid malignant, tumors. His microscopical studies were among the first in this field, and he detected that cancer of the testis regularly begins in the rete.

Ehrendorfer's contribution was valuable especially for the careful microscopical study and numerous excellent illustrations. Langhans seems to have been the first to use the microtome in his microscopical work and he with Kocher laid the basis for an accurate classification of testicular tumors according to microscopical structure. These observers recognized the carcinomatous nature of the alveolar sarcomata of former writers, they classed some of the apparently pure simple tumors with teratoma, and they began to suspect that the group of teratomata embraced a large proportion of all tumors of the testicle.

In 1896 Wilms submitted the extensive data regarding mixed tumors of the testicle to critical analysis. At that time current text-books described these tumors under a great variety of terms, while the relations between the different forms were largely ignored or imperfectly understood. Wilms showed that all the complex tumors of this group arise within the testicle and are of tridermal structure. He divided the tumors into two groups: (1) Embryomata, cystic tumors in which the elements presented a somewhat orderly imitation of a fœtus, and (2) Embryoid tumors or teratomata, more solid growths in which there was no orderly imitation of a fœtus. Numerous transition

forms, however, have been found to occur between these two groups, while the intratesticular location has been shown not to be invariable through the observation by Koslowski of a teratoma located in the tunica vaginalis. Wilms was familiar with the tendency of one element in a teratoma to predominate over the others, producing tumors which were chiefly cartilaginous, or myomatous, etc., and he found much carcinomatous and sarcomatous tissue in some of his cases, but he was disposed to follow previous teaching and separate the majority of pure simple tumors from the complex growths. He concluded that all the pure forms of connective tissue tumors, as fibroma, sarcoma, leiomyoma, and possibly lipoma and rhabdomyoma, arise in the testicle from the stroma cells or from simple misplaced groups of embryonal cells. Likewise pure adenoma, carcinoma, and cystoma arise from the tubule cells. The true teratomata he grouped in a separate class and thought they were derived in some way from sexual cells. Later he adopted the Marchand-Bonnet theory of origin from isolated blastomeres.

Not all observers at this time were able to thus sharply distinguish between several groups of testicular tumors or to attribute a different origin to the simple and to the complex growths. Monod and Terillon in an elaborate study concluded that there were all transition forms between the simplest and the most complex of testicular tumors, and that all were derived, according to Cohmheim's theory, from misplaced groups of cells.

In recent years numerous observations have tended to show that many benign and malignant neoplasms of the testicle formerly regarded as simple homologous tumors are of teratoid nature. Wilms, 1898, and Ohkubo, 1908, upon re-examining many tumors previously regarded as adenoma carcinoma, sarcoma, chondroma, myxoma, etc., were able to find in them derivatives of all three embryonal layers.

Pick, among others, has stated the principle that in teratomata one element may so greatly predominate as to obscure or even completely suppress all the others. This principle is illustrated in ovarian teratomata, in some of which there is practically nothing but thyroid tissue, and in the remarkable case of Saxer's in which the teratoma consisted of one well formed tooth lying in the ovary. Walthard cut into serial sections three large colloid tumors of the ovary and found in only nine sections traces of stratified epithelial cells, sebaceous and sweat glands. Ribbert has described three rhadomyomata of the testicle all of which were probably and one certainly of teratomatous nature. He is inclined to regard all chondromata and myomata of the testicle as of teratoid nature.

The predominance of one element in a teratoma giving rise to highly specific gross appearances and microscopic structures is best illustrated in those forms of teratoma testis which Schlagenhaufer identified as chorioma.

There were many previous observations which led up to the conclusion that this peculiar tumor is analogous to chorioma uteri. In 1868 Waldeyer observed polypoid tumor masses extending from a testicular teratoma into the pelvic veins, and he mentioned a striking resemblance between these masses and hydatid mole. A typical case of this sort was described by Breus (1878) in which the polypoid masses extended through the veins into the heart.

In 1896 an English commission decided against Marchand's view of the chorionic origin of chorioma uteri chiefly on the evidence presented by Kanthack and Pigg of a testicular tumor showing identical structures with those of chorioepithelioma.

In the French literature a series of cases of testicular tumors had been described by Malassez and Monod, Carnot and Marie, and others, under the title "sarcome angeioplastique," which bore a striking resemblance to hydatid mole, and in 1902 Wlassow pointed out the epithelial origin of these tumors and their resemblance to chorioma. A very typical case was described and clearly illustrated by McCallum under the term "lymphendothelioma." Hence the conditions had long been favorable for the conclusion of Schlagenhaufer that this variety of teratoma

testis is a true analogue of chorioma of the placenta. Schlagenhaufer, and almost simultaneously Wlassow and Steinert, reviewing the reported cases of this group in connection with their own material, pointed out the exact resemblance of this tumor with chorioma, traced the origin of the syncytial masses from the epithelial structures, identified glycogen-holding Langhans' cells, noted the hæmorrhagic character of the metastases, and showed that chorioma testis reproduces many essential features of chorioma uteri. Schlagenhaufer inferred that these gross and microscopical characters indicated the existence of a chorionic element in the original cell group giving rise to the tumor, a conclusion which favors the theory of origin of these growths from a sexual cell. Risel, however, while recognizing the general identity of the two forms of chorioma denies that there is any chorionic element in the cells of origin, referring the morphological resemblance of the testicular tumors to the mechanical effects of growth of a myxomatous tumor within blood-vessels. He refers to cases of primary myxomata of the heart and aorta reported by Marchand and by Fuhrman in which the intravascular growth assumed the appearance of hydatid mole.

Risel's argument seems to be colored by his desire to support the Marchand-Bonnet theory of origin of teratomata from isolated blastomeres. The evidence on which Schlagenhaufer bases his conclusion is extremely direct. The gross and microscopical appearance of chorioma testis and the mechanism and character of metastases are in some instances identical with those of chorioma uteri. The differentiation into polyhedral glycogen-holding Langhans' cells and vacuolated acidophile syncytial buds occurs in portions of tumors where the mechanical element must be entirely wanting. That chorioma testis has the physiological significance of chorioma uteri is further indicated by a remarkable case recently reported by Warthin, in which during the terminal stages of a chorioma testis with general hæmorrhagic metastases, there was hypertrophy of both breasts and the secretion of colostrum. Gabauini has also reported a case of teratoma testis with hypertrophy of the breasts and secretion of colostrum, which signs disappeared after castration. While this tumor was not recognized as a chorioma the description indicates that portions of it were of such nature. It seems reasonable to interpret these phenomena as physiological signs of pseudogestation in the male subjects of these tumors. The occurrence of encysted teratomata surrounded by an ectodermal membrane may also be interpreted as a reproduction of a fœtus with its chorionic investment. The stratified epithelial cells of this membrane are sometimes to be found in the epithelial lining of the villi in old hydatid moles.

Whatever may be the origin of chorioma testis it is evident that many testicular teratomata are largely or exclusively composed of choriomatous structures, the other elements being suppressed. The interesting history of "sarcome angeioplastique" and "chorioma testis" has thus led to the identification of both these neoplasms as one-sided developments of teratomata.

Having seen the gradual inclusion of many apparently unrelated benign and malignant tumors of the testicle into the single group of teratoma, suspicion arises that all or practically all testicular tumors may owe their origin to much the same embryogenic disturbance. While the majority of writers assume that tumors arise from the interstitial tissue and tubule cells of the testis it must be conceded that satisfactory proof of such origin is wanting, while the demonstration of the teratoid nature of many of these tumors is complete. Langhans in stating that adenoma and sarcoma arise from the tubule cells and stroma freely admitted that he assumed this origin without having found any definite facts in its support. Wilms in a similar situation, but with far more contrary evidence at his disposal, assumes that tumors arise from the stroma and tubules, but makes no attempt to support this view by specific data.

There is a certain logical ground for assuming that the highly specialized cells of the seminiferous tubules are incapable of origi-

nating tumors, but there is no such reason for supposing that the stroma and endothelium are any less capable of tumor growth than are similar structures in other organs. Nor can the failure of the literature to record satisfactory proof of the occurrence of such tumors be regarded as certainly excluding their existence. Yet, it appears to the writer that if two series of tumors arise in the testicle, one of teratomatous origin and the other from the adult stroma and tubules or from entirely different embryogenic disturbances in these tissues, then the two series of tumors ought to show distinguishing peculiarities in structure and clinical course. The tumors of teratoid origin and their various adenomatous, carcinomatous, and sarcomatous derivatives have the stamp of embryonal neoplasms, while growths originating in the functionating tubules and stroma, if such exist, may reasonably be expected to show other characters and to lack the embryonal stamp.

To obtain data on this subject I have consulted the literature and have studied a series of testicular tumors, and may anticipate the result of these two lines of inquiry by stating that I have been unable to find satisfactory evidence that any considerable proportion of tumors arise from the stroma or tubules of this organ. On the contrary, the evidence points to the conclusion that with relatively few exceptions tumors of the testicle belong in the embryonal class and that the great majority or possibly all of these embryonal tumors are of teratomatous origin.

In discussing the literature on testicular tumors the writer cannot claim that his review is exhaustive or his conclusions final. So many references have been consulted without result on account of the lack of detail in the reports that the conclusion was reached that the really valuable data were confined to a comparatively few well known treatises or monographs, as those of Curling, Ehrendorfer, Langhans, Monod and Terillon, Wilms, Debarnardi, Chevassu, and more recently Ohkubo. With rather few exceptions the clinical reports of cases have been found of little value for the present purpose, since the reports were not prepared from the point of view above stated. It is further necessary to emphasize the point that the present discussion concerns tumors of the testicle proper and not those of the scrotum, tunica vaginalis, or spermatic cord. Many clinical reports of tumors of the testicle are found on inspection to refer to tumors of adjacent structures, while in few instances has any systematic attempt been made to demonstrate the absence of teratomatous elements.

I. OCCURRENCE OF PURE SIMPLE TUMORS OF THE TESTICLE

Study of the Literature

The data regarding the occurrence of pure simple tumors of the testicle was discussed in detail by Kocher and Langhans in 1882.

Fibroma. Pure fibroma they found extremely rare, the two cases collected by Curling being among the few satisfactorily reported in the older literature. One of these (Paget's) grew slowly for seven years in a man of thirty-seven years of age before castration. The other (Marjolin's) was a lobulated growth resembling a uterine fibromyoma. Ehrendorfer describes a plexiform fibroma of the spermatic cord with myxomatous areas, and states that similar cases are recorded by Poisson, Dubois, and others. He also describes a large fibrolipoma of the vas and cord with giant cells resembling those of myogenous origin. Fergusson, 1869, and Pean have also described fibromas of the tunica albuginea, that of Pean having invaded the testicle. Kocher refers to two cases of doubtful nature, one of these developed in the corpus Highmori, reaching dimensions of 6.6 x 3 cm. It contained numerous small cysts filled with fatty detritus, and calcified areas while the main structure composed of hard fibrous tissue contained fatty detritus. The other was a calcified fibroma without recognizable structure. Monod and Terillon mention such cases and Wilms states that some are found in the collections in Zurich and Gottingen. Chevassu gives an excellent description of a large fibroma 14 x 9 cm. completely replacing the testicle. It consisted of cellular connective tissue, in places so cellular as to deserve the name of fibro-

sarcoma, elsewhere quite fibrous. In the center were several pseudocysts. Although he searched carefully and in vain for elements of a teratoma, he is not willing to affirm that the tumor was not a one-sided development of a teratoma. In recent literature I have been unable to find any other satisfactory report of a pure fibroma of the testicle. That such tumors exist seems certain, but, as Kocher says, on account of their rarity they have no clinical interest. Their origin has generally been referred vaguely to the interstitial tissue.

Chondroma. Most text-books describe pure chondroma of the testis, but the evidence pointing to the existence of such a tumor apart from a teratomatous basis appears to the writer uncertain. Dauvé in 1863 described twenty-eight cases of chondroma testis, of which Kocher accepts only five as pure chondroma, adding three cases of his own. In these supposedly pure cases it appears that the point of origin was as with teratoma, the tissue between epididymis and testis, that many of them were cystic, several occurred in infants, and in two cases (Paget, Kocher) there were cartilaginous metastases in lymph nodes or lungs. Paget's case is now generally regarded as a teratoma with predominance of cartilage (Wilms, Ohkubo), and the general description of the other cases strongly suggests a similar origin for all the chondromata of the testicle. The same conclusion would seem to apply to the rare osteochondroma, of which Neumann has described one case.

Wilms in discussing chondroma testis points out their resemblances to teratoma, and considers whether they do not all have a teratomatous origin, but will not go so far as to claim that pure chondroma testis does not occur. Ribbert, however, leans to the opinion that chondroma testis is always of teratomatous origin.

Myxoma. The majority of the reported myomata of the testicle have been associated with chondroma, sarcoma, adenoma, or cystoma, and clearly belong in the teratoid group. Kocher and Langhans could find no case of pure myxoma. Some of the purest cases resemble Waldeyer's with invasion of the veins and metastases, and belong in the group of chorioma testis. Although Wilms assumes that the interstitial tissue of the testicle may give rise to pure myxoma he does not refer to any specific reports of such cases. At present there seems to be no evidence to support this view.

There is reason to believe that myxoma of the testicle is closely related to chondroma and that myxomatous areas with giant cells may result from the degeneration of islands of cartilage.

Lipoma. Wilms considers it doubtful if any pure lipomata of the testis have been observed. Kocher does not mention such cases, and I have been unable to find any in the recent literature. Lipomatous areas occur rather infrequently in teratomata.

Lipoma of the spermatic cord is not a very infrequent tumor. In 1895 Sazarin collected twenty-six such cases from the literature. The origin of these tumors is not clear but that they have any relation to teratoma testis is doubtful. Yet Ehrendorfer describes a large fibrolipoma located in the spermatic cord and containing giant cells recalling those of myogenous origin. Porges' case suggests a teratoid origin for some of these tumors. His specimen consisted chiefly of lipoma, with an extensive calcified area, much smooth muscle tissue, and diffuse large cell sarcoma. Kolisko pronounced it a teratoma.

Myoma. Pure leiomyoma seems to have existed in a case of Trelat's. Eighteen months after a trauma, a myoma was found involving the site of the vas deferens, the walls of veins and arteries, the corpus Highmori, and the obliterated canals of the epididymis. This tumor seems to have involved the testicle secondarily rather than originated within it. The origin was supposed to be in the cremaster internus muscle or in the walls of vessels. Rindfleisch also has described the gross appearance of a leiomyoma testis. Nepveu's case showed striated as well as smooth muscle fibers, and was probably of teratoid nature.

Hericourt has described two small cystic leiomyomata of the epididymis which seem to have arisen from the muscular walls of the

canals in that organ. Compared with the frequent occurrence of leiomatous areas in teratomata, pure tumors of this class, if they occur at all, are of very slight clinical interest.

Rhabdomyoma. Kocher collected six reported cases of this type. Arnold described one case, while Ribbert added three cases. In the cases of Rokitanski and Neumann the tumor was attached to the lower pole of the tunica albuginea and this position is perhaps some evidence in favor of Neumann's view that these tumors may arise from the gubernaculum of Hunter. In this position it is not strictly a tumor of the testicle. In Kocher's other cases the testicle itself was involved. In Arnold's case there were epithelial canals in the outer portions of the growth which suggest a mixed origin. Ribbert discusses the possible origin from the gubernaculum; but thinks that the presence of epithelial structures in many testicular rhabdomyomata indicates an origin from more complex cell groups. One of his cases was combined with carcinoma and sarcoma.

Both Neumann and Ribbert found many spindle and round cells in their cases which were not readily identified as myomatous, and Neumann suggested that some spindle cell sarcomata regarded as fibroblastic might really be of myogenous origin.

Benenati describes a large rhabdomyoma of an undescended testis with metastases n abdominal lymph nodes. The tumor contained much striated muscle tissue, areas of spindle cells lacking striation, and also a type of "neoplastic tissue" composed of small round cells with little protoplasm, large vesicular nuclei, and one to three nucleoli. The lymph nodes contained only the neoplastic tissue. This tumor was obviously not a pure myoma. Wood's case is of interest as showing an excessive development of striated muscle in a teratoma containing cartilage and epithelial cysts.

Considering the great frequency of smooth and striated muscle in teratomata, and the rarity of anything approaching a pure myoma testis, a probability is established that all myomata of the testicle are of similar teratomatous origin. Since scanty epithelial structures have been found in nearly pure myomata a complete sectioning of the whole tumor would seem necessary before ruling out a mixed origin for this growth. With the possible exception of Trelat's case, and the leiomyomata attached to the lower pole of the tunica albuginea, there seems to be no satisfactory proof of the occurrence of pure myoma of the testis except as a one-sided development of a teratoma.

Adenoma. The older authors described the occurrence of pure adenoma of the testis, attributing its origin to proliferation of the tubule cells. The chief support of this view lay in the elaborate study of Langhans, who described in detail the forms of so-called cystic adenoma. Yet Langhans states that he could not trace the origin of the adenomata to the tubule cells, but accepts this origin in absence of any other hypothesis. Aside from the simple cysts of the testicle which may safely be referred to dilatation of tubules of epididymis, rete or testis proper, he divided the true cystic tumors into cystoadenoma mucosum and cystoadenoma atheromatosum, the former containing mucoid material and the latter fatty or sebaceous detritus. He found the cysts lined by all varieties of epithelium, columnar, ciliated, and squamous, while the stroma often contained cartilage or striated muscle. It is obvious, as Wilms showed in 1896, that Langhans was dealing with cystic teratomata, and not with pure adenomata of the tubule cells. In Langhans' descriptions I have been unable to find any evidence strongly suggesting the occurrence of pure adenoma derived from the tubule cells, nor does such evidence appear in the writings of numerous other observers, including Klebs, Birch-Hirschfeld, Orth, Ziegler, Monod and Terillon, Duplay and Reclus, Koenig, Wilms, and others. Ehrendorfer's adenoma testis is clearly a teratoid carcinoma. It seems reasonable to assume that adenomatous proliferation of lining cells may readily occur in dilated tubules of epididymis or testis, in which case the tumor should be distinguishable from the teratoid cystic adenoma, but the occurrence of such tumors in the testicle has not been proven nor have their distinguishing features been pointed

out. The idea that the common adenomata of the testicle are derived from the tubule cells is therefore practically abandoned, but current opinions regarding their true origin are divided, some assuming with v. Recklinghausen that they originate in remnants of the Wolffian body, others that they represent one-sided developments of teratomata. Ribbert inclines to the latter view, but Wilms still admits that some adenomas arise from the seminal tubules, without offering any direct evidence in support of this view.

The existence of a pure adenoma of the seminal tubules has been demonstrated by Chevassu and by Pick, who have pointed out characteristic clinical, gross, and microscopic features which sharply separate this rare tumor from the teratoid adenoma. The pure adenoma has been observed only in two cases of undescended testis, one of them in an hermaphrodite. The tumors appear as pinhead or bean sized yellowish nodules in the body of the atrophic testis. Occasionally they contain small cysts formed by dilated alveoli. They are composed of regular tubules lined by cylindrical cells about 15 micra in height with finely granular cytoplasm, compact nuclei, and arranged in palisade fashion. The transition from the normal tubules to the adenomatous may be followed step by step. Chevassu likens the alveoli to those of a sweat gland. The significance of these multiple adenomata of atrophic testicle appears to be similar to that of multiple adenomata of the cirrhotic liver.

Sarcoma. This formerly extensive group of testicular tumors has been narrowed by the elimination of many cases of carcinoma which were once regarded as alveolar sarcoma. Langhans and Kocher in 1887 recognized the probable carcinomatous nature of the alveolar sarcomata of former writers and definitely placed them in the class of carcinoma.

A further extensive inroad was accomplished when, as previously stated, Wlassow found that the "sarcome angeioplastique" of the French authors was a derivative of neuroepithelial structures in teratomata.

Lymphadenoma and lymphosarcoma. An apparently distinct group of primary sarcoma of the testis was carefully described by Malassez in 1874 and later by Talavera and other French observers. It had previously been observed by Curling in 1866 and by Lucke, and there is reason to believe that it had been observed but differently interpreted by many others. Ehrendorfer in 1882 described a typical case with cutaneous metastases, and his report is accompanied by a sketch of the structure. Monod and Terillon and Duplay and Reclus devote considerable attention to it, and Langhans seemed to accept as genuine the occurrence of this specific variety of sarcoma of the testis, but many authors do not mention it. In current French literature reports of such cases are rather numerous. The disease is distinguished in the majority of cases, by the involvement of both testicles, by its rapid course, by the development of multiple metastases, especially in the skin, and by its histological structure which resembles that of a lymphosarcoma. It is composed of round cells lying in a reticular stroma. Lymph follicles are absent. The exact origin and significance of this tumor have not been determined. Many of the brief reports in recent French literature strongly suggest that the descriptions are of very cellular forms of the ordinary round cell "sarcoma" of the testis. In some of these reports the cells are described as large, polyhedral from pressure, and with large vesicular nuclei and nucleoli. Eosinophile and mast cells are sometimes present, and the stroma may be infiltrated with small lymphocytes. Cornil in commenting on such a case reported by Morestin warns that the diagnosis of lymphadenoma should be made with caution since "one may have to deal with an embryonal sarcoma." Chevassu is very positive that the lymphadenoma of French authors, especially those reported by Monod and Terillon, is the same tumor as his "seminome" (teratoma). He has examined the tumors reported as lymphadenoma by Morestin and Milian in 1899 and finds them typical "seminomes," a view with which Milian himself now acquiesces. He points out that the cells of the lymphadenoma are much larger than lymphocytes, while a considerable

reticulum develops in the "seminome" which is of epithelial origin. In his extensive collection, there was but one lymphosarcoma and that a secondary deposit in the testis.

Debarnardi describes three small round cell sarcomas of the testis and endeavors to distinguish between them and the large cell growths. Only one of the cases could be regarded as primary in the testis. The tumor cells were described as very similar to large and small lymphocytes.

It is thus extremely difficult to determine the exact nature of the small round cell tumors described by the above authors. It seems certain that many of the cases reported as lymphosarcoma were really the common large cell carcinoma of the testis, and it is equally certain that this carcinoma may yield a picture very similar to that of the "lymphadenoma." Recent writers as Monod and Terillon and Debarnardi are agreed that a primary lymphosarcoma of the testis is a very rare tumor. That all lymphosarcomata of the testis are secondary to tumors in other parts of the body, as maintained by Chevassu, is however, too sweeping a conclusion. Debarnardi's third case meets all reasonable requirements of a primary lymphoma of the testis, and case 18 of the present series is undoubtedly lymphosarcoma and primary in the testis.

The exact origin of this tumor appears uncertain. It is customary to assume that it arises from pre-existing lymph nodes, but this view for the testicle requires an assumption similar to that made by Langhans when he erroneously derived adenoma of the testis from the seminal tubules. In the writer's case the tumor arose in the rete testis, which is the point of origin of teratomata, and this fact suggests that the origin of lymphosarcoma is in some way connected with that of teratoma. The nature of this connection, if it exists at all, is at present entirely obscure, and there appears to be no direct observation which could be used in support of an hypothesis that lymphosarcoma testis is of teratomatous nature.

Spindle cell sarcoma is of rare occurrence in the testicle. Langhans could report no cases of this type. Kocher refers to several cases of true sarcoma most of which were composed of round cells and which probably belong among the lymphoid and diffuse epithelial tumors. One of his cases of small spindle cell sarcoma occurred in a child of two and a half years. It contained many giant polynuclear spindle cells. Among several sarcomata of the testicle reported by Ehrendorfer one was a spindle cell tumor originating in the corpus Highmori, containing 60 cc. of hydrocele fluid and growing diffusely between the tubules. The structure suggests an origin from the stroma of the testicle, but there were myxomatous areas and groups of large polyhedral cells in some portions of the tumor. The probability that teratomatous elements have been overlooked in many of these cases has been shown by Wilms, who on examining an old tumor called a plexiform spindle cell sarcoma and largely composed of that tissue, found also some small cysts lined by cylindrical or squamous epithelium, and an island of cartilage undergoing mucoid degeneration. Monod and Terillon refer to cases of spindle cell sarcoma without giving details which warrant a conclusion regarding the exact structure and origin. One seems to have been a spindle and giant cell tumor. Krompecher describes a large spindle and giant cell sarcoma with perivascular arrangement in a man 39 years of age. The numerous giant cells were of myeloid type. The tumor was interpreted as a growth from the perivascular connective tissue. It seems to have been a pure spindle and giant cell sarcoma but the origin of the giant cells is uncertain, and the large size of the tumor made it impracticable to eliminate the possible presence of other elements. Debarnardi describes a spindle cell sarcoma of the testis in a boy of fifteen years which he assumes to have originated indefinitely in the stroma. Yet the tumor was myxomatous in places, contained round and giant cells, was rich in glycogen and gave metastases in the lymph nodes. It seems possible that this tumor contained a myogenous element, but in any case it does not strongly favor the view that pure tumors arise from the stroma of the testis. Chevassu (1906) out of 127 primary tumors of the tes-

ticle found only one which he could possibly regard as of pure sarcomatous nature. The specimen consisted of a testicle of twice the normal size and an equally large growth, involving the epididymis and cord. The growth was composed of small round cells consisting chiefly of nucleus, elongated cells twisted in various shapes and often surrounding capillaries. The stroma consisted of interwoven connective tissue fibers. On account of the presence of certain alveoli lined by epithelioid cells, the author expresses the suspicion that this tumor was possibly a form of cancer infiltrated with connective tissue and lymphocytes. The tumor proved very malignant, the patient dying six months after castration.

The existence of a pure spindle cell sarcoma of the testicle would seem, therefore, to require further demonstration. There is no doubt that tumors composed chiefly of spindle cells do occur in this organ, especially in young subjects, but their entire freedom from other elements, the derivation of the giant cells, and their possible relation to myoma and teratoma are as yet undetermined.

Tumor of interstitial cells. In 1872 Waldeyer described under the term "plexiform angeiosarcoma" tumors of the testicle and other regions which in the testis he believed to originate from the large interstitial cells. He pointed out the resemblance of these cells in form and position to the perithelial cells described by Eherth in the adventitia of the cerebral arteries, while the structure of the tumors, especially the grouping of the cells about blood-vessels, suggested their origin from perithelial cells. Langhans could not accept Waldeyer's conclusions, but in 1895, Hansemann believed he was able to recognize certain sarcomata of the testicle as originating from the interstitial cells. He did not accept all the plexiform sarcomata of the testicle included by Waldeyer as belonging in this group. Hansemann's tumors were characterized chiefly as small alveolar sarcomata with stroma infiltrated with round cells and of which the tumor cells showed "such a striking resemblance to the large interstitial cells as to leave no doubt of their origin." It does not appear that the existence of this specific variety of sarcoma of the testicle has been widely accepted. The brief references of Waldeyer and Hansemann seem rather to suggest the possibility that such a tumor occurs than to establish the fact. In the writer's cases certain tumors resembling the structures depicted by Hansemann have occurred as portions of teratomata, and seem to fall in the class of diffuse carcinomata. (See Fig. 4.) In two teratomas Wilms observed a marked increase of the interstitial cells of the testicle and similar cells were scattered in considerable numbers in portions of the tumor. Other writers note that the interstitial cells are sometimes increased, sometimes diminished, in cases of teratoma, and this statement applies to the writer's cases. Krompecher concluded that the tumors referred to by Hansemann are identical with the large cell alveolar sarcomata, and Debarnardi agrees with this view.

The question of the relation of the interstitial cells to tumors of the testicle seems to have been set at rest by the observations of Chevassu. It seems reasonable to assume that a neoplasm derived from the interstitial cells should contain cells quite different from those of the common round or polygonal cell tumors and that the abundant pigment contained in the cells of origin should give the tumor a distinctly brownish tint. Exactly such features have been observed in a tumor described by Chevassu which he regards as originating in the interstitial cells.

The subject was twenty-seven years of age, had been operated upon several years before for inguinal hernia, after which an undescended testis on this side had steadily increased in size until it was as large as a small hen's egg. On section the testis had a reddish yellow color. It was composed of masses of large polygonal cells containing deeply staining granules in a voluminous cytoplasm and a small nucleus, but no crystals. The resemblance to the interstitial cells was said to be complete. Chevassu was inclined to regard the condition not as a malignant tumor but rather as a benign hyperplasia of adenomatous type. He states that Kaufmann has observed three similar cases.

In an undescended ovotestis in an hermaphrodite Gudernatsch, in this laboratory, found the atrophic tubules largely re-

placed by areas of diffuse proliferating interstitial cells. The organ had a distinctly reddish brown color. This condition seems to me identical with that encountered by Chevassu, but I regard it as a simple hyperplasia of the interstitial cells and not a tumor. That any other tumor of the testicle arises from the interstitial cells seems very unlikely and is quite unproven.

Carcinoma. The exact scope of the term carcinoma as applied to testicular tumors has never been sharply defined. While portions of teratomata may show areas composed of defin te adenocarcinoma or large alveolar carcinoma, these histological structures are seldom observed except in mixed tumors. Langhans recognized a scirrhus and a medullary form of carcinoma. Both varieties, especially the latter, seemed to occur in pure form, and it is chiefly to this medullary cancer that attention has been directed as a probable form of pure carcinoma of the testis. The medullary carcinoma of Langhans was a grayish white, firm, or soft tumor composed of large polyhedral cells, with large vesicular nuclei and cytoplasm rich in glycogen. The cells were arranged in large indistinct alveoli or grew diffusely, separated at times by fine fibrils of reticular tissue or by firmer fibrous tissue, as in the scirrhus form. Often the stroma was richly infiltrated with lymphocytes. The rather indefinite carcinomatous features of many of these medullary tumors led to much uncertainty in the diagnosis of carcinoma testis. Many such growths have been reported as alveolar sarcomata; others as lymphomata; and as the exact origin of the tumor was obscure many writers designated their cases simply as large round cell tumors of the testicle. These round cell neoplasms show such similarity to the others in gross appearance, clinical course, and mode of metastasis through the lymph nodes, that in recent years the impression has steadily grown that this entire group, including the most frequent tumors of the testicle, is of carcinomatous nature. Regarding the origin of this tumor opinions are at variance, and three possible sources have been considered: (1) The tumors are sarcomata derived from the corpus Highmori (Ehrendorfer) or from the interstitial cells (Hansemann). (2) The tumors are endotheliomata derived from lymph vessels (Krompecher). (3) The tumors are carcinomata derived from adult spermatic tubule cells (Langhans, Chevassu), or from embryonal tubule cells (Debarnardi), or from misplaced embryonal cell groups (Monod and Terillon).

(1), (2) The theories of the sarcomatous nature of these tumors as well as of their origin from the interstitial cells have been generally abandoned.

(3) Both Birch-Hirschfeld and Langhans traced the origin of cancer of the testicle to the spermatic tubule cells and both observers accepted this origin for the common types of carcinoma. Langhans especially describes in great detail the gradual transformation of the tubules into carcinomatous alveoli, finding that the hyperplasia affects the spermatoblasts while the supporting follicular cells disappear. Yet these observations were made at a time when the question of the connective tissue or epithelial origin of cancer was a live problem, and when the microtome was not in general use, so that their validity for the present purpose must be doubted. Langhans noted the occurrence of many cystic carcinomata, and finding fat tissue, cartilage, and bone in some cases he suggested that carcinoma of the testis might have a teratomatous basis. Later Wilms demonstrated the teratomatous nature of several reputed carcinomata of the testicle, but here again he assumed that such tumors may arise from the spermatic tubules. Among recent writers Debarnardi describes in detail four typical large cell tumors and discusses their origin. Having failed to find any other elements he believes they were not mixed tumors. Although he could not trace the origin of the tumor to the seminal tubules he assumes that they arose from the spermatoblasts or their embryonal equivalents on account of the morphology of the cells, and the structure and mode of growth of the tumors, especially their gradual replacement of the testis.

Chevassu also assumes an origin from the spermatoblasts for the large round cell tumor of the testis which he designates as "semi-

nome," and which he considers is unrelated to teratoma. He regards as unreliable the observations of Birch-Hirschfeld, Langhans, Tizzoni, and Talavera, who claim to have traced the tumor cells directly back to the spermatoblasts. He has never been able to secure this decisive piece of evidence. He goes further than Debarnardi and claims that the tumor arises from the adult and not from embryonal tubules. This conclusion is based on the exact resemblance of the tumor cells to certain spermatogonia in the deeper layers of the tubular lining, as seen in the testes of recently executed criminals. He would even venture to identify certain tumors as arising from the superficial cells and others as coming from the deeper cells of the seminal tubules. Moreover the growth of these tumors gradually replacing the testis and uniformly distending the tunica vaginalis is regarded as possible only by a tumor arising from seminal tubules.

While recognizing that the arguments of Debarnardi and Chevassu are ably constructed, I cannot accept their conclusions, for the following main reasons:

(1) The typical large cell tumor of the testis with large round clear cells and lymphoid stroma is a highly characteristic structure which is duplicated by no other tumor, while its various derivatives are connected with the typical form by numerous transitional cases often illustrated in the same tumor. Yet this characteristic tumor is exactly the type of carcinoma which occurs in the complex teratomata of the writer's series. In case 1 it occurred in combination with chorioma and chondroma, in case 2 with adult thyroid, and in other cases covering much of the natural history of teratoma testis. Its teratomatous relations are therefore not a matter of assumption, but a readily demonstrable fact.

(2) Occurring apparently free from teratomatous elements it may be held that when the characteristic carcinoma occurs in teratomata one has to deal with two distinct tumors, the tubule cells being incited to neoplastic proliferation as Langhans suggested, by the presence of the teratoma. This unorthodox assumption, while worthy of consideration, lacks any recognized basis.

(3) The belief that the large cell tumor of the testicle occurs in pure form free from any relation to teratoma is based on the failure in many cases to find such other elements. Yet, as Chevassu admits, the tumors are received for examination only after they have become well advanced in growth. In advanced tumors according to the principle of the predominance of single elements in teratomata, there is opportunity for the complete suppression of slowly growing and scanty structures in the original focus. In the writer's case (1) the minute islands of cartilage would soon have been overgrown and destroyed by the rapidly advancing carcinoma. The failure to find teratomatous elements in a well established large cell tumor of the testis is inadequate to disprove its teratomatous origin.

(4) Teratomata containing carcinoma with lymphoid tissue are not limited strictly to the body of the testis, as in Koslowski's case. There the appearance of the characteristic lymphoid stroma shows that this stroma is not a derivative of the testis but is an integral part of the tumor. The tunica albuginea is not always uniformly distended, but considerable portions of the testis are often found at one pole of the tumor. The usual fate of the tubules is compression atrophy, although some are distended by tumor cells in a way which suggests an origin from the lining cells. Ribbert has shown how deceptive and unreliable are the appearances on the edges of rapidly growing tumors. The only tumor known to be derived from the tubule cells is the adenoma of Pick and Chevassu, but the evidence regarding its origin is quite different from that adduced for the large cell carcinoma.

The resemblance of the tumor cells to spermatogonia cannot be regarded as a strong indication of the origin of our tumor from these cells. In the true adenoma of the testis the cells are quite different from the cells of origin and it is impossible to imagine why in the more malignant carcinoma the cells should revert to the normal type.

For these reasons I believe that the common large cell carcinoma of the testis is not derived from the adult tubule cells, but is a one-sided development of a teratoma.

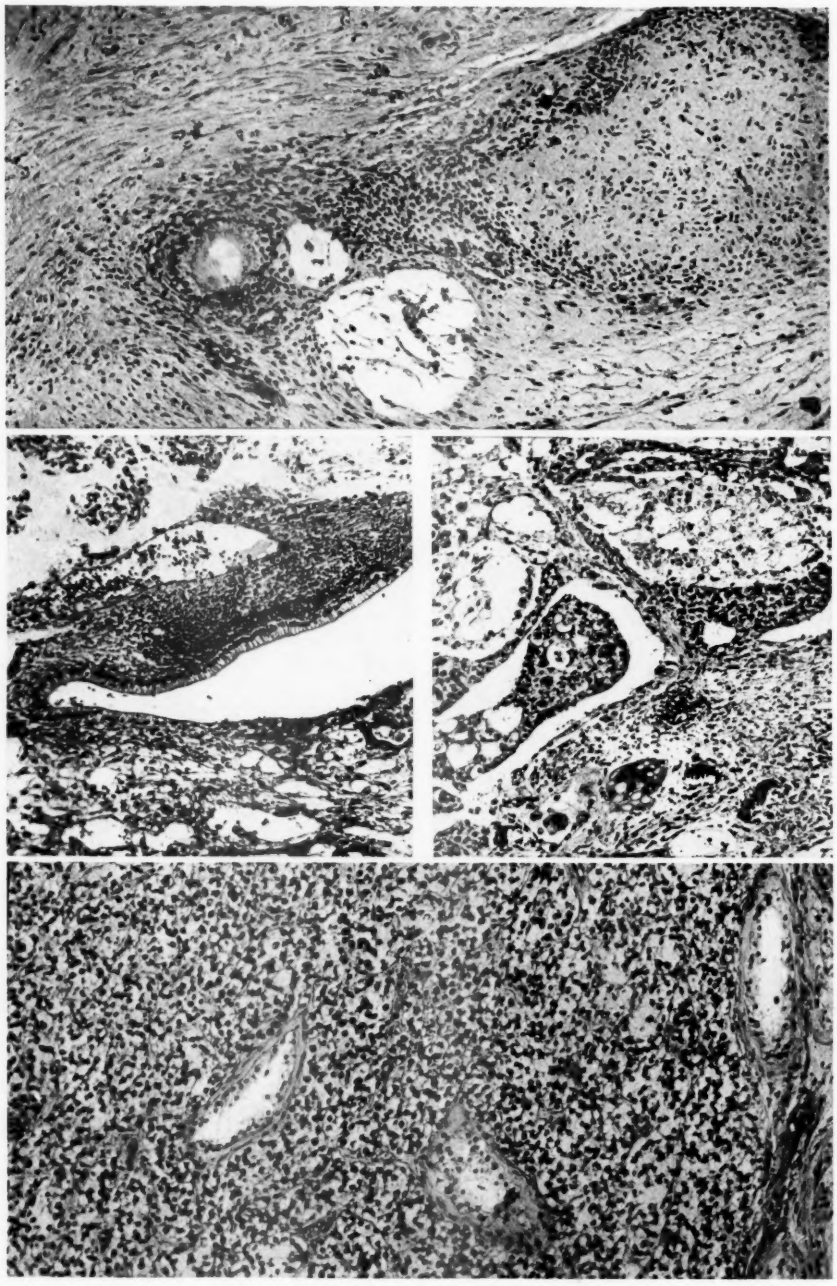


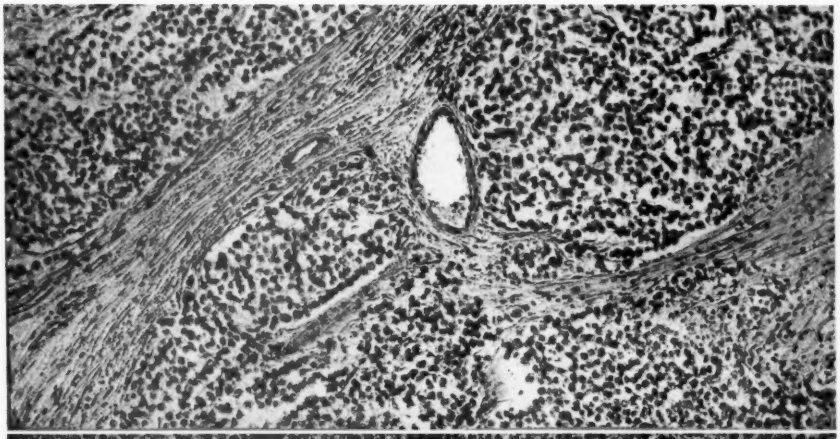
Plate I. Various structures in tumor of case 1.

Fig. 1. Island of cartilage, alveolus lined by columnar epithelium, and embryonal connective tissue.

Fig. 2. Irregular cavity lined by high columnar epithelium.

Fig. 3. Mixed tissue with syncytial masses resembling chorioma.

Fig. 4. Diffuse carcinoma invading testicular tubules.



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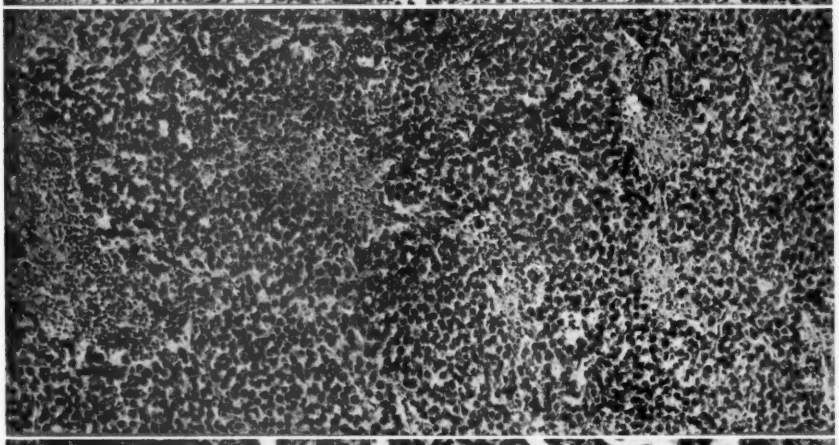

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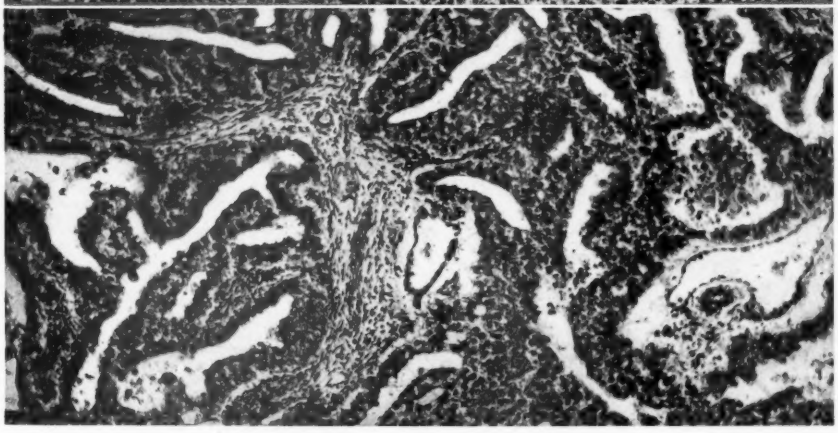

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Plate II. Different types of embryonal carcinoma occurring in pure form and in portions of teratomas.

Fig. 5. Carcinoma with indistinct alveolar structure. "Alveolar sarcoma."

Fig. 6. Diffuse large cell tumor of testis with slight lymphoid infiltration of stroma.

Fig. 7. Adenocarcinoma.

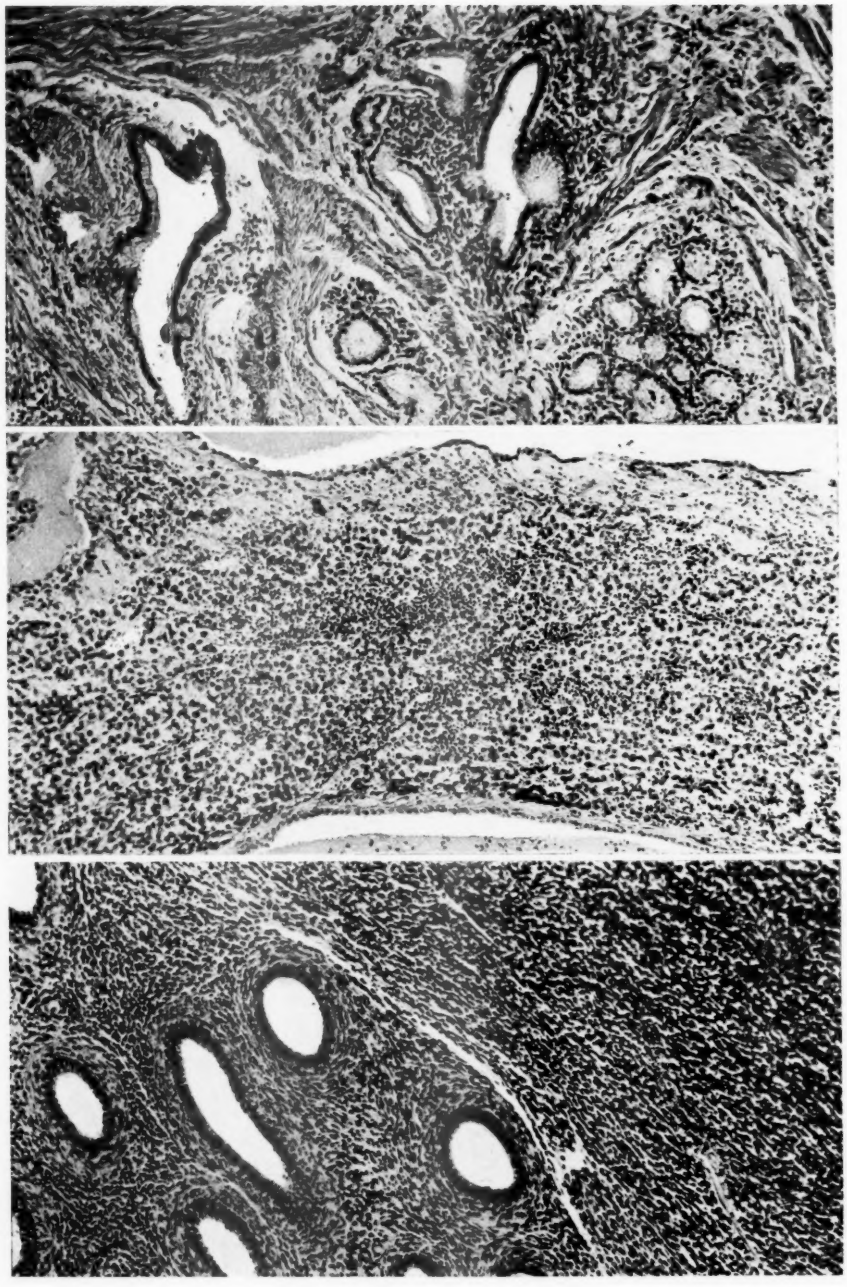


Plate III. Tumors in cases 2 and 19.

Fig. 8. Glandular structure in adult fibromuscular organ, case 2.

Fig. 9. Carcinoma with lymphoid stroma, case 2. Alveoli of adult thyroid appear on either side of septum, which is infiltrated with carcinoma.

Fig. 10. Tubules of epididymis invaded by lymphosarcoma, case 19.

II. STUDY OF ORIGINAL CASES

Early Teratoma Testis, Showing Cartilage, Chorioma, Squamous Epithelium, Adenocarcinoma, and Diffuse Carcinoma

CASE 1. Dr. X., age 38 years. Following a moderate trauma some months before, the patient noticed a slight tender swelling of the upper portion of the right testicle. The symptoms persisted with some gradual increase in the size of the testicle for six months, when the organ was excised by Dr. Samuel Alexander, to whom I am indebted for the specimen and history.

Gross examination. The testicle is slightly enlarged by a tumor mass 2 x 1¼ x 1 cm. lying in the region of the corpus Highmori and slightly involving the epididymis and testis. On section it is composed of two rather distinct portions, one being rounded, hæmorrhagic, sharply circumscribed from the testis, and joined by a fibrous area to the second portion which spreads irregularly ½ to 1 cm. into the testis. Some distance from the main tumor is an isolated nodule the size of a pea.

Microscopical examination. On section the first portion is found to be composed of adenocarcinoma with choriomatous structures, some dilated alveoli, and embryonal connective tissue, the second portion and outlying nodule are carcinomatous, while the firm intervening tissue contains mucoid connective, embryonal cartilage, and some alveoli lined by high cuboidal epithelium. Ectodermal tissues are represented by one minute cyst lined with squamous epithelium and by the choriomatous structures. Entoderm seems to have yielded only minute cysts lined by high columnar epithelium, and possibly the diffuse carcinomatous lobule. Mesodermal derivatives are a single island of cartilage, myxomatous tissue, and embryonal connective tissue. (See Plate I.)

While the tridermal origin of the growth is demonstrated, the case is remarkable first on account of the scanty representation of entoderm and mesoderm and the advanced neoplastic character of the ectodermal derivatives.

A second important conclusion drawn from the microscopical examination is that if this tumor had been allowed to grow to the size of a hen's egg it would have been practically impossible to have discovered the cyst lined by flat epithelial cells or the island of cartilage, and the tumor would have been regarded as adenocarcinoma or chorioma in one portion and diffuse carcinoma or alveolar sarcoma in the others. As the diffuse carcinomatous invasion of the testis was evidently proceeding at a rapid rate this structure would eventually overgrow the adenocarcinomatous parts and the tumor would appear as a diffuse carcinoma or large cell sarcoma.

A third significant feature of the case is the exact reproduction in the small bulk of this early teratoma of the structure of three forms of carcinoma, each of which appears in the testicle in apparently pure form. These structures are (1) chorioma, Fig. 3, (2) large cell adenocarcinoma, Fig. 7, and (3) diffuse carcinoma or alveolar sarcoma, Fig. 4.

One has then to deal with a very early teratoma testis progressing rapidly by the growth of several types of carcinoma and capable of yielding eventually one of the pure types of carcinoma testis.

It was not possible to identify the embryonal structures giving origin to these carcinomatous areas. The diffuse carcinoma infiltrated the testis distending some alveoli with cancer cells in the manner described by Langhans and causing atrophy of other tubules, but since it formed a definite portion of a teratoma there is no reason for assuming that it arose from the testicular tubules. Since the three types of carcinoma observed in this teratoma are highly characteristic embryonal neoplasms their association in one teratoma indicates that when these types of carcinoma are encountered, as is often the case, in apparently pure form, they should be interpreted as one-sided developments of a teratoma, which owes its origin to a single definite embryogenic disturbance.

Complex Teratoma, with Epidermoid Cysts, Thyroid, Fibromuscular Organ Resembling Uterus, and Extensive Carcinoma with Lymphoid Stroma

CASE 2. Patient, J. M., age 61 years. For two months previous to admission to St. Francis Hospital, August, 1909, the right testicle had been rapidly increasing in size. The organ was enlarged to the size of a goose egg, hard, not tender, and without pain. On August 10th it was removed by Dr. John Rogers to whom I am indebted for the specimen and history.

Gross structure. The specimen measures 9 x 7 x 5 cm. The cord is thickened and edematous and contains one carcinomatous nodule. The tunica albuginea is everywhere thickened, but intact. The epididymis is embedded in edematous new tissue and carcinoma but it is otherwise intact. A

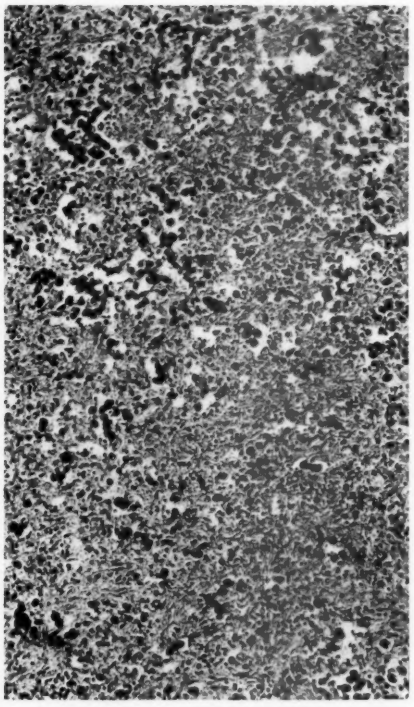


Fig. 11. Case 9. Regressing carcinoma. The stroma contains degenerating and poorly stained tumor cells, indistinct fibrillæ, lymphocytes, and a few plasma cells.

small segment of testis, recognized microscopically, lies below the epididymis, as indicated in the text figure which reproduces the general anatomy of the growth. The tumor contains four main structures, (1) a series of epidermoid cysts filled with sebaceous material, (2) three islands of adult thyroid tissue, (3) a fibromuscular and glandular organ, and (4) diffuse carcinoma. (See sketch on p. 248.)

Microscopical examination. The testicular remnants are in the last stages of atrophy, the tubules being extensively hyaline and acellular.

The epidermoid cysts are lined with stratified squamous epithelial scales, which are sometimes transformed into giant cells with englobed fat crystals.

The thyroid lobes are identical in appearance with normal adult human thyroid. The colloid is in slight excess and the various stages of its formation through Hürthle's acidophile cells can be accurately traced. The stroma contains a few lymph follicles.

Thyroid tissue, so common in ovarian teratomata, is very rare in the testicle.

Szulczweski has described two testicular tumors containing thyroid tissue. One was a partly calcified adenoma of which the peripheral portions were composed of large spaces lined by a single row of cuboidal cells and filled with colloid. The other was a large necrotic carcinoma, which closely resembled carcinoma of the thyroid and was composed of many small and large alveoli lined by several layers of cells and filled with colloid. The first of these tumors seems to have shown genuine thyroid tissue of a teratoma. As to the nature of the other the author's hesitation in regarding it as a genuine thyroid tumor was based on the resemblance to certain endotheliomas of the parotid with colloid degeneration.

The fibromuscular glandular organ is difficult of interpretation but shows a striking resemblance to an elongated convoluted uterus or to a stomach. It measures 4 x 3 x 2½ cm., is enclosed in a definite capsule, and is composed of an elongated muscular tube twisted into position and appearing in several cross sections. It is embedded in adult fat tissue. The smooth muscle wall ¼ cm. in depth closely resembles that of the adult uterus. The glandular lining of high columnar epithelial cells forms shallow glands exactly resembling those of the uterus. They are supported by a cellular stroma in which the

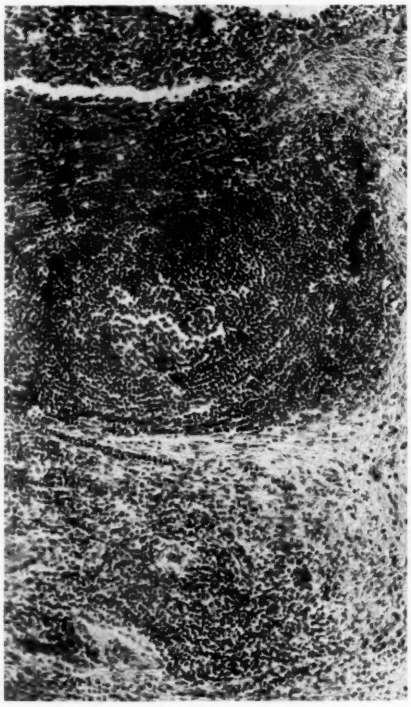


Fig. 12. Case 10. Lymph follicle, on the edge of embryonal carcinoma with lymphoid stroma.

spindle cells of the uterus are lacking. (Fig. 8.) In suggesting that this organ is a uterus I am reminded of Schlagenhaufer's caution that many interpretations of embryonal structures in teratomata are largely fantastical. Yet the structure is an imperfect imitation of some organ, and while a stomach or possibly a prostate may be the true key to the mimicry, the resemblance is more pronounced to the uterus. The position near thyroid and a probable dermal structure is hardly a sign of importance. Fibromuscular areas have been found in teratomata by several observers, but apparently no such organ as the present one.

The carcinomatous areas compose the main bulk of the tumor. (Fig. 9.) The structure is uniformly that of the characteristic embryonal carcinoma with lymphoid stroma. This peculiar stroma is unusually abundant, and scattered at regular intervals throughout are many normal lymph follicles with proliferating centers. The appearance of this tissue under these conditions demonstrates that it is not the result of an inflammatory process but a part of the neoplasm constituting this a specific variety of carcinoma not occurring elsewhere. It is largely upon the evidence of this case that I assume the teratoid origin of apparently pure cases of carcinoma testis with lymphoid stroma. The epithelial cells are large, polygonal, nuclei highly chromatic and vesicular, texture of cytoplasm loose. They are arranged in large groups, or long rows or about vessels, or diffusely. There is little necrosis. The origin of the carcinoma is wholly unrevealed, but there, as in other cases, the evidence is strongly against an origin from the testicular tubules.

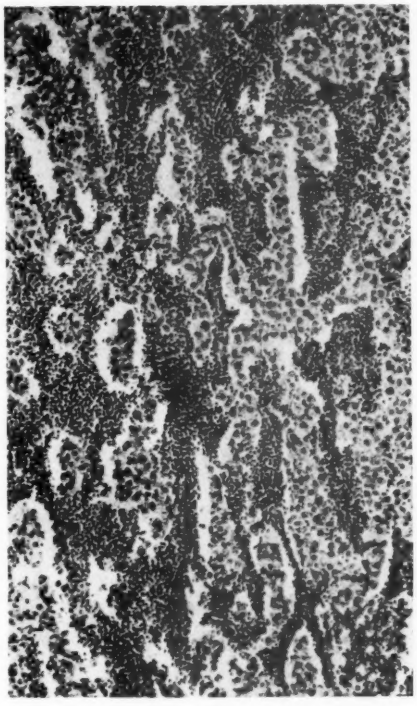


Fig. 13. Case 10. Embryonal carcinoma, with lymphoid stroma.

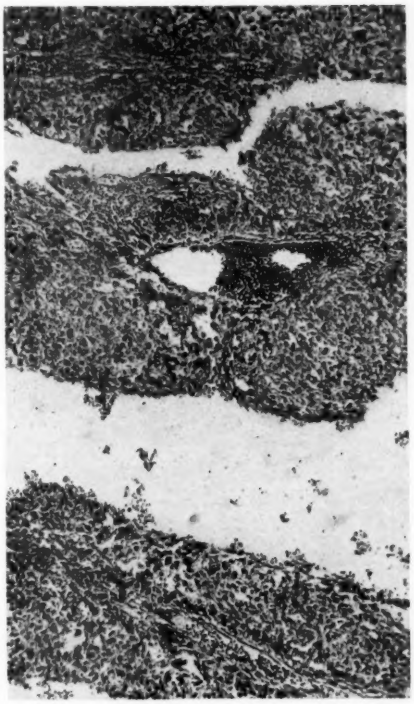


Fig. 14. Case 16. Teratoma testis, recurring as perithelioma.

Adenocarcinoma, with Islands of Cartilage, and Bundles of Smooth Muscle Tissue

Case 3. Dr. S., age 37. Testicle removed for supposed tuberculosis, February, 1905. There was no recurrence. The specimen is a testicle enlarged by a tumor mass distending the organ to a narrow peripheral rim about one segment of the tumor from which it is sharply demarcated. The tumor measures 6 x 5 cm. It is well encapsulated, soft, and on section shows many small cysts filled with blood, surrounded by gray opaque tissue infiltrated with blood.

Microscopically the growth is composed chiefly of adenocarcinoma, the cells being of large size,

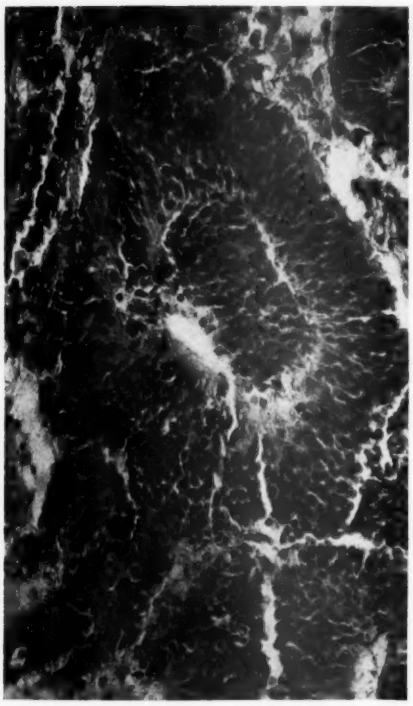


Fig. 15. Case 17. Neuroepithelial cell rests.

with nuclei densely staining and arranged in convoluted bands and complex alveoli, in which one layer of epithelial cells is invaginated within another. In some places the cells are growing diffusely and occasional foci are observed where the epithelial cells form large acidophile vacuolated syncytial masses. Mesodermal elements appear in the form of very cellular connective tissue, a few minute islands of cartilage, and bundles of smooth muscle. No definite epidermal structures were found. A peculiar feature is the appearance of areas of large spindle cell sarcoma in which the cells are arranged in bundles as in myoma. The presence of such tissue about some alveoli lined by columnar epithelium also suggests a myogenous origin for the areas of spindle cell sarcoma.

This case is an adenocarcinoma of teratomatous origin, with slight representation of mesodermal elements and no discoverable epidermal structures. That the epidermal layer was entirely wanting cannot be claimed, since the whole tumor was not cut in serial sections.

The main bulk of the tumor is identical in appearance with the adenocarcinomatous portions of case 1. (See Fig. 7.)

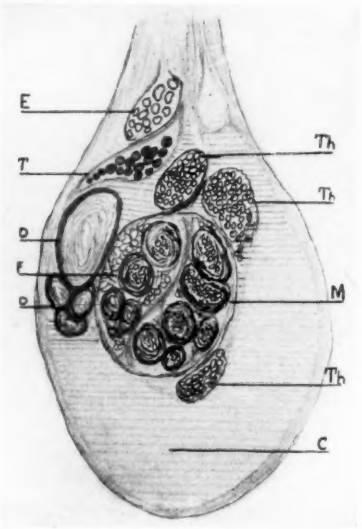
Teratoma Testis Showing Adenocarcinoma, Spindle Cell Sarcoma, and Cysts Lined by Columnar and Ciliated Epithelium

Case 4. Patient, F. S., 36 years. Tumor of testicle removed at New York Hospital, October 12, 1904.

The specimen consists of normal spermatic cord and epididymis and a testicle enlarged by a tumor mass, and measuring 5 cm. in diameter. The testicular tissue is largely replaced by tumor tissue which is soft gray and lobulated.

Microscopical examination. The tumor is composed of small areas of adenocarcinoma lying in sarcomatous tissue. The carcinomatous areas exactly resemble those of case 3. (Fig. 7.) Some of these areas are surrounded by very cellular sarcomatous tissue in which are many lymphocytes and occasional lymph follicles. Long papillary projections resembling intestinal villi appear at some points. The sarcomatous tissue is composed of small spindle cells lying in a granular or mucoid matrix. No cartilage or muscle was found, but the entire tumor was not sectioned. Two small cysts were found lined by columnar ciliated epithelium.

This tumor clearly belongs in the class of teratomata, the presence of ectoderm remain-



Construction of a Teratoma Testis. (By ½.) Case 2. C, Carcinoma with lymphoid stroma. D, Epidermoid cysts, E. Epididymis. F, Fat tissue. M, Fibromuscular organ. T, Remains of testis. Th, Thyroid tissue.

ing uncertain. It seems to represent an early stage of the same process marked in case 3, in which cartilage was very scanty and no islands of stratified epithelium were found.

Teratoma Testis, Showing Chiefly Adenocarcinoma, with Sarcomatous Stroma and Minute Islands of Cartilage

CASE 5. The specimen was received from Bellevue Hospital in 1899. Data regarding the history, exact source, and gross appearance are wanting. The clinical diagnosis was sarcoma of testis, and the specimen was set aside under the microscopical diagnosis of adenocarcinoma.

On re-examination of the stained sections the tumor reveals the character of an embryonal carcinoma of teratoid origin. The bulk of the growth is composed of large alveoli lined by a layer of large cuboidal cells with densely staining nuclei, and a second separate layer of cells is invaginated into many alveoli, as in case 1. (Fig. 7.) In places the stroma is composed of broad bands of spindle cells without matrix. In the cellular septa two small islands of cartilage were encountered. The tumor is therefore of complex embryonal type and suggests a predominance of the adenocarcinomatous structure as seen in cases of teratoid carcinoma. Remains of testicular tubules filled or surrounded by tumor cells appear along the edge of the growth.

Adenocarcinoma and Diffuse Carcinoma Testis with Teratoid Characters

CASE 6. The material at disposal is limited to three stained sections from different portions of a testicular tumor submitted to me for diagnosis in 1902 by Dr. Newton Evans. The clinical diagnosis was carcinoma.

Although the examination of this tumor is quite imperfect, the case is included in the present series on account of the combination in it of two types of carcinoma which are common in teratoid tumors of the testicle.

The tumor is chiefly composed of carcinoma in which large hyperchromatic polyhedral cells lie diffusely or in groups supported by thick bands of stroma richly infiltrated by lymphocytes. This histological picture may be designated as embryonal carcinoma with lymphoid stroma. In one of the sections appears an area of the peculiar adenocarcinoma of case 1 with invaginated layers of hyperchromatic cells. The impression that this tumor is a one-sided development of a teratoma is based on its composition of two highly characteristic types of embryonal carcinoma each of which occurs in undoubted teratomata.

Teratoma Testis, Showing Adenocarcinoma, Large Alveolar Carcinoma (Sarcoma), and Diffuse Carcinoma

CASE 7. The specimen was received from the General Memorial Hospital in 1899 and after routine examination was placed in the collection under the diagnosis carcinoma. The tumor is a speroidal mass, diameter 8 cm., soft, central portions necrotic, the testis destroyed, the epididymis persisting intact along the upper border. Original diagnosis, carcinoma.

Microscopical examination shows the growth to be composed exclusively of carcinoma, no mesodermal elements being present in large sections of the tissue. Three carcinomatous structures are represented, (1) adenocarcinoma with alveoli containing double rows of large cells, similar to those found in case 1. (Fig. 7.) Such areas are very scanty. (2) Alveolar carcinoma or "sarcoma" composing the bulk of the tumor. (Fig. 5.) (3) Diffuse carcinoma, which sometimes shows a perivascular arrangement or is supported by bands of stroma richly infiltrated by lymphocytes.

The diagnosis of teratoid cancer is based on the exact reproduction of the peculiar types of carcinoma observed in case 1 and in the presence of a characteristic carcinoma with lymphoid stroma such as appears in other teratomata of this series. The tumor shows a predominance of alveolar carcinoma and partial suppression of adenocarcinoma, while any mesodermal elements such as were found in case 1 would readily have been lost in the extensive necrotic process.

Carcinoma Testis with Teratoid Characters. Alveolar "Sarcoma," and Carcinoma with Lymphoid Stroma

CASE 8. Patient, F. S., admitted to New York Hospital, March 25, 1904, with a recurrent tumor of the testicle. The original tumor and testicle had been removed several months previously and no information regarding it could be obtained. The present tumor was located in the scrotum involving the skin. It measured 7 x 8 x 6 cm. Attached to the mass is a small piece of skin of scrotum. The consistence is moderately firm. The section presents a mottled appearance, grayish yellow and necrotic areas alternating with gray translucent areas. Several lymph nodes accompany specimen. Microscopically the tumor is composed chiefly of the peculiar type of alveolar carcinoma formerly called sarcoma, described in case 7. (Fig. 5.) Some portions of the growth, however, show more chromatic polygonal cells lying between bands of connective tissue richly infiltrated by lymphocytes. (Fig. 9.) That these two structures belong to one tumor seems a reasonable assumption and since both structures appear in undoubted teratomata, the conclusion is reached that this case is a carcinoma of teratoid origin.

Carcinoma Testis of Teratomatous Nature. Carcinoma with Lymphoid Stroma

CASE 9. Patient G. New York Hospital. June 13, 1907. Testicular tumor removed at operation

measures 9 x 8 x 5.5 cm. It is soft and slightly fluctuating. The tunica vaginalis is smooth and shows numerous large injected veins. On section the tumor is sharply separated from the remains of atrophic testicular tissue by a thick connective tissue capsule. The greater portion is necrotic, and the intact portion has the appearance of soft brain tissue. No cysts or islands of cartilage were seen. Microscopically the tumor is composed of small groups, or rows, or diffuse areas of large polyhedral cells supported by thick bands of cellular tissue. The nuclei of the tumor cells are large and highly chromatic. The supporting stroma is composed of spindle cells and fibrillæ or a hyaline matrix infiltrated with small lymphocytes and some plasma cells. In some areas the well stained tumor cells are limited to small groups lying in a tissue composed of degenerated polyhedral cells with faintly staining nuclei and supported by indistinctly fibrillated material. These appearances suggest a spontaneous regressive process. (Fig. 11.) No trace of columnar or flat epithelium, cartilage, or muscle, or any other common feature of teratoma could be found.

The conclusion that the tumor is a one-sided development of a teratoma is based on the fact that its highly peculiar structure is exactly duplicated in other tumors of this series in which tridermal elements were demonstrated.

Embryonal Carcinoma with Lymphoid Stroma

CASE 10. C. H. G. (7929), 44 years, admitted to New York Hospital, June 20, 1903. Patient stated that a tumor of the testis had been removed October, 1900, of which the nature was not stated. About January, 1903, he first noticed a recurring tumor at the site of operation which steadily increased in size.

The specimen is a rather firm tumor measuring 3 x 2.5 x 2 cm. Incised surface is grayish, smooth, glistening. Attached to its upper part is 2.5 cm. of a slightly enlarged vas deferens.

Microscopical examination. The tumor is composed chiefly of large polygonal cells with vesicular nuclei and clear cytoplasm. These cells lack any definite arrangement but about some venules they assume a perithelial grouping. The scanty stroma contains many lymphocytes and there were some small lymphoid follicles. Sections throughout the tumor failed to reveal any feature of mixed tumor growth, but the whole structure presents the peculiar characters of carcinomatous portions of teratomata. The structure is very similar to that described in the carcinomatous areas of case 2. (Fig. 9.)

Carcinoma Testis with Lymphoid Stroma

CASE 11. Patient, F. B., age 38 years. Admitted to New York Hospital, March 21, 1903, with a tumor of the testicle which had been noticed for about one year. The specimen removed at operation measured 8 cm. in diameter. The tissue is soft, vascular, and grayish in color, except in the areas of necrosis, which are very numerous. A pyramidal projection, 3.5 cm. in length and 3 cm. in breadth at the base apparently represents invasion of the spermatic cord by the tumor. A portion of the thickened scrotum and tunica vaginalis 9 x 5 cm. accompanies the tumor.

Microscopically the tumor is composed exclusively of the characteristic embryonal carcinoma with lymphoid stroma. (Fig. 12.) There are many minute areas of anemic necrosis. In the more vascular portions there is a tendency for the cells to assume a perivascular arrangement.

Carcinoma Testis with Lymphoid Stroma

CASE 12. Patient, S. S., was admitted to New York Hospital (8546) with a tumor of the testicle which was removed at operation.

The specimen consists of testicle, epididymis, spermatic cord, and a lymph node. The testicle measures 4 x 4 x 3 cm. and the normal tissue appears to be almost entirely replaced by tumor tissue in the form of closely packed round nodules, 3 x 10 mm. in diameter. The tissue is gray as of a neoplasm, except in areas of necrosis which are fairly numerous. Cord and epididymis are edematous but free from tumor. The lymph node, 3 x 2 x 1.5 cm., contains necrotic areas. Microscopically several portions of the tumor were examined and found to be composed of embryonal carcinoma with lymphoid stroma. There were some wide areas of diffuse carcinoma without stroma, for which the nutrition was provided by channels traversing the cellular masses. Atrophic testicular tubules surround one portion of the tumor. The lymph node contains necrotic and fibrous areas in which are islands of diffuse carcinoma.

Carcinoma with Lymphoid Stroma, in Undescended Testis

CASE 13. Patient, Dr. B., age 37 years. Operation for tumor of undescended testis, June, 1908. A portion of the tumor was sent to me for diagnosis by Dr. W. B. Coley, to whom I am indebted for the reference to the case.

The material consisted of several large pieces of opaque hardened tumor tissue, without cysts or necrosis. A portion of epididymis is present. Microscopically the tumor is composed exclusively of carcinoma with lymphoid stroma. Besides the lymphocytes the stroma contains embryonal connective tissue and pale staining cells resembling endothelium. There is little necrosis. The epididymis is intact but testicular tubules were not found.

Carcinoma with Lymphoid Stroma, in Undescended Testis

CASE 14. The material consists of sections of a tumor of an undescended testicle submitted, December, 1908, for diagnosis, by Dr. W. S. Gottheil, to whom I am indebted for the privilege of referring to the case. The patient had some years before

suffered a sharp blow in the inguinal region from a cricket ball. A tumor in that region had appeared several months before operation and steadily increased in size.

The sections show the characteristic structure of embryonal carcinoma with lymphoid stroma. The connective tissue of the stroma is more adult in type than usual.

Carcinoma with Lymphoid Stroma

CASE 15. The material consists of sections of tumor kindly placed at my disposal by Dr. F. M. Jeffries. In 1907 a large soft tumor of the testicle was removed. In 1908 there were signs of recurrence in the abdomen. Microscopically, the sections show embryonal carcinoma with stroma richly infiltrated by lymphocytes.

Teratoma Testis. Recurring as Perithelioma

CASE 16. J. P., Austrian, New York Hospital, January 16, 1906. The original specimen is a testicle largely replaced by a tumor 10 x 6.5 x 5.5 cm. The epididymis is not clearly made out. The tunica vaginalis is not involved, nor are the vas and cord. On section the tumor has a grayish color with numerous yellow areas of necrosis and many small cysts. First recurrence May 17, 1906. A mass was removed from the scrotum 8 x 4.5 cm. It is soft, fluctuating, and covered with a thin capsule. On section the upper fourth presents a translucent yellowish appearance, while the lower three-fourths are composed of opaque soft tissue, the center of which is broken down and contains bloody fluid. Second recurrence, September 21, 1906. The specimen consists of a mass of tumor tissue as large as a goose egg. Surface is irregular, consistence soft, section presents hæmorrhagic areas. Accompanying the tumor are a few enlarged lymph nodes which proved to be uninvolved in the tumor process.

Microscopical examination. The original tumor contains many of the elements of a teratoma. Those observed include cartilage, smooth muscle bundles, and small cysts lined by columnar or ciliated or stratified squamous epithelium, neuroepithelial cell nests, and lymph nodes, while much of the tumor is composed of islands of carcinoma in which large polygonal cells with clear cytoplasm lie in large groups inclosed by scanty stroma.

The first recurrence exhibits chiefly a highly malignant structure of perithelial carcinoma, the tumor cells being identical in appearance with the carcinomatous cells of the original growth. There are also a few areas of cellular connective tissue containing alveoli lined by columnar cells, some neuroepithelial islands, and many large blood spaces.

The second recurrence is composed exclusively of the peritheliomatous structure and closely resembles adrenal perithelioma. (Fig. 14.)

This case therefore illustrates an original tridermal teratoma with carcinomatous areas, with complete elimination of all but the carcinomatous elements in the second recurrence.

Teratoma Testis Containing Cartilage, Cysts Lined by Columnar or Stratified Epithelium, and Neuroepithelial Cell Groups

CASE 17. Received from New York Hospital May 21, 1907.

The specimen consists of an enlarged testicle, epididymis, and a portion of the vas deferens. It measures 9 x 6 x 5.5 cm. The surface is covered with a network of enlarged veins. Consistence elastic, in places slightly fluctuating. On section the tumor bulges above capsule and involves both testicle and epididymis. Surface irregularly mottled, with grayish yellow areas. It has a somewhat hyaline succulent appearance and contains numerous very minute cysts filled with viscid blood-tinged material. Near the head of epididymis are a number of bluish white translucent nodules, size of pinhead. (Cartilage.)

Microscopical examination. The tumor is composed chiefly of embryonal connective tissue in which lie many small areas of cartilage and irregularly placed epithelial structures. Many small cysts are lined by columnar epithelium which merges into low cuboidal cells with chromatic nuclei. There are many small alveoli composed of large cuboidal cells with large nuclei, unsupported by connective tissue, and on the edges similar large epithelial cells are diffusely infiltrating the testicle, displacing the spermatic cells. One area is composed chiefly of neuroepithelial cell nests. (Fig. 15.) A single cavity is lined by transitional epithelium and supported by smooth muscle bundles. There are a very few small cysts lined by stratified squamous epithelium.

The original structures are much obscured by extensive mucoid degeneration and widespread necrosis. The tridermal origin of the tumor is evident but there is no attempt at orderly arrangement of the elements. The specimen illustrates the group of solid teratomata, with cancerous degeneration.

The distended zones of testicular tissue show great excess of interstitial cells and atrophy of tubules.

Cystic Teratoma Testis, Carcinomatous Degeneration

CASE 18. The history of this case was not received. It was an old specimen from the New York Hospital collection.

Microscopical examination. The tumor is composed chiefly of embryonal connective tissue in which lie a large number of small dilated alveoli lined by high cuboidal or columnar epithelium. In many of the alveoli the lining cells constitute a single row, in others there are several rows, and in some the cells are very numerous without orderly arrangement and exhibit the features of an adenocarcinoma. One small cyst lined by squamous

epithelium was found. The stroma is cellular and exhibits much mucoid degeneration. No islands of intact cartilage were seen but some of the mucoid areas approach the structure of softened cartilage.

This tumor therefore exhibits derivatives of at least two germinal layers, ectoderm and mesoderm, and clearly belongs in the group of teratomata. It is remarkable for the predominance of the one element of minute cysts lined by cuboidal epithelium which sometimes exhibits carcinomatous changes.

Lymphosarcoma Primary in Rete Testis and Epididymis. Metastases in Skin, Inguinal and Abdominal Lymph Nodes, Liver, and Kidneys. Duration Twelve Weeks

CASE 19. A. R., aged 5½ years. American. Well nourished, always healthy. About July 1, 1909, parents noted a swelling of right testis which increased rapidly, reaching size of a small hen's egg, with involvement of inguinal nodes and overlying skin. July 30, removal of tumor and three enlarged lymph nodes extending up to internal ring. Wound healed promptly, but after two weeks there was increasing anemia, loss of flesh, fever, and prostration. September 1st several firm nodules appeared in skin of face and neck. Blood not examined. With rapidly increasing anemia, fever, and weakness, patient died September 15th. Autopsy by Dr. H. S. Martland, to whom I am indebted for the material and history.

Gross examination. The tumor of the testis measures 3 x 2½ x 2½ cm. It involves the corpus Highmori, rete, and epididymis and fuses their structure with the surrounding tissues. In the overlying skin there is a diffuse invasion. A circumscribed portion of intact testis which is found to be the whole organ lies at the upper posterior pole of the tumor sharply separated by a fibrous partition. The tumor is firm, well encapsulated, and free from necrosis.

The retroperitoneal lymph nodes are much enlarged, the largest measuring 1¾ cm. in diameter. In both kidneys there are areas of diffuse infiltration. The lungs and liver show several miliary lymphomata. The spleen is moderately enlarged, section smooth, firm, grayish, follicles nearly invisible. Throughout the colon are numerous follicular ulcers. Peyer's patches appear normal. The mesenteric lymph nodes are slightly swollen. Attached to the peritoneal surface of the colon are several small movable lymphomata.

Microscopically, the testicular tumor is composed of diffuse areas of small and medium sized lymphocytes. Many cells show distinct cell body. This neoplastic tissue widely separates the intact tubules of rete and epididymis and invades the neighboring fat lobules. (Fig. 10.) The larger lymphnodes are completely replaced by medium sized tumor cells. In the capsules of the main tumor and of the lymph nodes, in the fat tissue, in the small lymph nodes, skin, and kidney, there is diffuse infiltration by small lymphocytes. In the liver the portal canals are infiltrated with small lymphocytes, sometimes producing small lymphomata. In the kidney tubules are very numerous calcific deposits. In the lymph nodes are numerous masses of bacteria. In the lung are a few minute lymphomata. In the spleen there is a diffuse growth of medium sized lymphocytes throughout the pulp, while the follicles are reduced in size.

The histological features of this tumor are in all respects typical of malignant lymphosarcoma. The exact origin of the tumor is perhaps not entirely clear. That the original tumor arose in the testis seems a necessary conclusion from the relative size of the tumors, that in the testis being much larger than any of the lymph nodes, and showing local outgrowths of considerable extent as well as extensions in the overlying skin. Since the only testicular tissue found was entirely free from invasion by lymphocytes while the rete and epididymis are extensively involved, one must conclude that the tumor originated in the epididymis or rete and not in the body of the testis. Since this is the point of origin of most testicular tumors, I am led to believe that this tumor is an example of a genuine primary lymphosarcoma of the testis. If this view is correct, Chevassu's belief that all lymphosarcomata of the testis are secondary cannot be accepted.

Although a careful search was made in all portions of the tumor no trace of teratomatous elements was discovered. Many islands of smooth muscle tissue were scattered in the region of the epididymis, but these all seemed clearly to be normal muscle cells derived from the cremaster. Since the general lymph nodes were not involved the tumor was not of systemic origin and cannot be classed with the pseudoleukemias. The lesion in the spleen had the appearance of a secondary process not of neoplastic nature. One may suppose, according to current custom, that the tumor arose from normal lymphoid tissue in the rete or epididymis, but it must be admitted that this view is a pure assumption. The conditions of the origin of this tumor are unknown.

CONCLUSIONS

The conclusions reached from a review of the literature and the study of the present cases may be stated as follows:

Pure fibroma arising from the stroma of the testicle has probably been observed but is extremely rare.

Pure leiomyoma arising from smooth muscle structures of the epididymis or corpus Highmori has probably been observed in a case of Trelat's but does not appear in recent literature.

Chondroma, myxoma, lipoma, rhabdomyoma, and carcinoma have not been shown to exist apart from a teratomatous origin. Primary lymphosarcoma arises in the testicle but its exact cells of origin are as yet undetermined. It may first appear in the rete testis as do teratomata. Pure spindle cell sarcoma probably arises in the testicle but is rare and its exact origin is uncertain.

Alveolar, large round cell, perivascular, and other forms of so-called sarcoma testis are of epithelial and teratomatous origin. Adenoma arising from the spermatic tubule cells is a rare tumor occurring in atrophic undescended testes.

Considerable hyperplasia but no true tumors of the interstitial cells have been observed.

The commonest tumor of the testis is an embryonal carcinoma alveolar or diffuse with polyhedral or rounded cells and often with lymphoid stroma. These tumors are probably one-sided developments of teratomata.

III. THEORIES OF ORIGIN OF TERATOMA TESTIS

The views held regarding the origin of teratoma testis have varied with the progress of the knowledge of tumors in general, but have mainly followed the course of embryological conceptions.

1. *The theory of cell metaplasia.* Virchow assumed that the complex testicular tumors arose from the normal elements of the organ by a process of cellular metaplasia, all the epithelial structures coming from the epithelium of the testicular tubule and the connective tissue derivatives from the stroma. This theory maintains its hold in some current text-books and in reports of cases of simple tumors of the testicle, but has never gained favor as an explanation of the heterologous growths or the complex tumors of tridermal type. However, it still remains an open question how far metaplasia may affect the structure of teratomata, for it may well prove that the complex tissues of established teratomata are not entirely the result of the unfolding of original cell potencies.

2. *The theory of fœtal inclusion* was suggested by Saint Donat's original case and was definitely adopted by Geoffroy Saint Hilaire and by Verneuil. According to this theory teratomas must be regarded as of bigerminal origin involving two embryos, the host and the tumor, as distinguished from a monogerminal origin in which but a single embryo is concerned. Teratomata would then fall in the category of fœtal monstrosities rather than with true neoplasms. Although this theory has later given place to more specific hypotheses it is still regarded by Borst and others as a possible explanation of some teratomata.

Sobotta has lately reviewed the various hypotheses regarding the mechanism of twinned monsters. (1) The fertilization of multinucleated ova, examples of which have several times been observed. (2) The development of two embryonal anlagen in one germinal vesicle. In support of this possibility is cited Asheton's observation of two separate germinal areas in one ge minal vesicle in the sheep, and Kopsch's report of a double gastrula in the turtle. In birds and fish many instances of two embryos in one yolk sac have been observed. (3) The fusion of two contiguous ova in the uterus, with inclusion and suppression of one embryo.

The chief objections to the theory of fœtal inclusion are found in the rare and somewhat uncertain observations on which the theory is based and in the wide distinctions which separate definite twinned monsters from the comparatively rudimentary structure of teratomata. It may satisfactorily apply to the former conditions but supplies more than is needed for the origin of teratomata. Wilson fertilized binucleated sea urchin ova and found that all three nuclei fused with the formation of one normal embryo.

3. *The theory of partial hermaphroditism.* According to the assumed laws of development of the sex organs the sexual cells must originally possess the potencies of both ova and spermatozoa, and as the differentiation proceeds toward male or female the opposite potencies must lie dormant or partially suppressed in certain cells of ovary or testis. Waldeyer regards Pfhuger's tubes, which consist of a network of epithelial cell nests in the fœtal ovary, as representing the partially differentiated sex cells of this organ, while in the fœtal testicle he finds primordial ova in the form of large clear cells with large nuclei, and from these structures he derives the cystomata and teratomata of these organs.

The suppression of the opposite type of sex cell in ovary or testis does not always occur. Thus cyclostomata possess testes with an upper ovarian portion and were long regarded as protoandrous. In amphibia the presence of ova in the upper end of the testis is not uncommon. Wilson's observations on the influence of the accessory chromosome in sex determination stand against the theory of suppressed sexual potencies. These observations tend to show that sex is determined at the moment of fertilization by the varying character of the spermatozoon, so that no potencies of the opposite sex exist in the developing embryo. True functionating ovotestes have not been observed in vertebrates. Yet some forms of partial hermaphroditism approach such a condition. In a recent case reported by Gudernatsch from this laboratory a small ovary was found embedded in a fold of an undescended testicle. Langhans, 1871, observing a teratoma apparently inclosed by the testicle but not invading it, suggested that teratomata may develop from an isolated ovarian rudiment in the testicle. Somewhat similar views are expressed by Kockel. These authors suppose that primordial ova in the testis may become fertilized by spermatozoa and give rise to embryoid tumors. Against this theory stand the absence in most teratomata of fœtal envelopes which ought to develop about a fertilized ovum, the occurrence of teratomata outside the sex organs, and the lack of proof that functionating ovotestes or primordial ova, or any process of fertilization occurs in the human male. Waldeyer assumes that fertilization of such primordial ova is not necessary, and that they may develop through parthenogenesis. Bonnet, however, discards the theory of parthenogenesis on the grounds that the primordial oögonia can produce only true ova, and that parthenogenesis of ova or oögonia does not exist, all appearances so interpreted being the result of regressive degenerative changes. Moreover, parthenogenesis in insects, where it appears most prominently, occurs only in adults and only in females.

Waldeyer's theory that parthenogenesis plays a part in the origin of teratomata has been abandoned, but perhaps too hastily. Bataillon has induced true parthenogenesis in frog's eggs, the resulting embryos exhibiting a considerable although incomplete power of development. Harvey has tabulated more than a score of methods for the experimental production of parthenogenesis, some of which are successful in frogs.

True parthenogenesis with the production of perfect embryos may not occur in other vertebrates, but teratomata are not perfect embryos, and it is conceivable than an incomplete form of parthenogenesis may account for the rudimentary growth of embryomata. Ribbert is loath to abandon the belief that teratomata must arise exclusively in the sex cells, that origin alone adequately explaining the predominance of such tumors in the testicle and ovary.

4. *Theory of fertilization of polar body.* Marchand and Bonnet having discarded the bigerminal hypothesis have considered the possibility that teratomata may arise from fertilized polar bodies. The position of the polar body after the first cleavage stage of the ovum obviously suggests that a proliferative process established in it might readily result in such structures as appear in teratomata. That position, however, fails entirely to account for the frequency of teratomata in the sex organs. Bonnet points out that polar bodies are known to become fertilized, and in mammals they persist for some time and may be recognized lying among the blastomeres. In rabbits spermatozoa

have also been observed about many blastomeres. So the conditions for the fertilization of polar bodies have been shown to exist. Bonnet therefore believes that fertilized polar bodies may give rise to aberrant blastomeres which go on to develop teratomata. Parthenogenetic development of polar bodies has been induced in Thalassema mellita by Lefevre, employing the same methods as were used to excite parthenogenetic development in the ova. Yet the progressive development of a polar body to any great extent has not been observed above the flat worms and Ribbert points out that more than two or three polar bodies have never been seen in one ovum, while he has observed four separate teratomata on one ovary. Hofmeier, also, observed five separate dermoids in one ovary and two in the other ovary of the same subject. (Borst.)

It is reasonable to assume that a fertilized polar body if pursuing the course of development into an embryo would produce fœtal membranes. Hence much theoretical importance attaches to the significance of the chorion-like structures in some teratomata. If these structures represent abortive fœtal membranes, their occurrence favors the origin of teratomata from a polar body or sex cell rather than from an isolated blastomere which requires no new membranes. Yet in the armadillo four embryos of the same sex are regularly produced from one ovum, each of the first four blastomeres appropriating and isolating a portion of chorion with which it becomes surrounded. (Lane.)

5. *Theory of an isolated blastomere.* As an alternative to the origin from blastomeres produced from polar bodies Marchand and Bonnet assume that the isolated blastomeres may arise from the ovum itself in the early stages of cleavage. It has been shown by Wilson for amphioxus up to the eight cell stage of cleavage and by Zoja up to the sixteen cell stage in a hydroid, that any one cell if separated from the others may sometimes go on to develop into an entire embryo. One may suppose that a blastomere becoming isolated and possessing all the potencies of the ovum, may produce the most complex types of embryomata.

To account for the predominance of embryomata in the sex organs Marchand suggests that the sexual cells are very early separated from the others and may thus more readily inclose the isolated blastomeres. In Ascaris one of the first two blastomeres goes to form the sex organs and here the chances are even that the sex organs would include any blastomere isolated in later cleavages. (Boveri.) In mammals the sex cells are differentiated later but still probably at a relatively early period.

Bonnet offers the fact of the wide extent of the anlage of the sexual organs which stretches from the anterior to the posterior pole of the embryo. Ribbert discards both these explanations as inadequate.

It must be admitted that the Marchand-Bonnet theory fails to satisfactorily account for the predilection of teratomata for the sex organs and it would seem also to imperfectly explain the wide diversity in the structure of teratomata and especially for the less complex varieties. These considerations have led many to search for the origin of teratomata and simpler mixed tumors in cell complexes isolated at a later period of embryonal differentiation, and possessing more limited potencies. For the wide variation in the structure of teratomata two contending hypotheses have been maintained.

(1) It was first widely held that varying degrees of metaplasia of more or less differentiated cells led to the growth of many tissues in one tumor, but the modern tendency is to restrict the field of metaplasia, and to assume that the complex tissues and organs of teratomata are the natural expression of the potencies of the originating cells. The principle of the predominance of one element of a teratoma, e. g., the muscle element, is a much better explanation of the less complex tumors than is the theory of metaplasia of well differentiated cell groups.

(2) Wilms assumes that the varying structure of teratomata and mixed tumors depends upon the period of embryonic differentiation at which the originating cell complex is isolated. The less differentiated the cell group the more complex will be the resulting tumor. This theory which approx-

imates the conception of Cohnheim, opens the door to innumerable hypotheses regarding the time and place of the isolation of cell groups giving rise to teratomata and greatly complicates the question of their origin. It has formed the basis of many classifications of testicular and ovarian tumors. Thus Pilliet and Costes divide testicular teratomata according to their supposed origin from (1) epithelium Pflugerienne, giving voluminous solid tumors with few cysts, (2) epithelium Wolffian, yielding small tumors with many small cysts, and (3) epithelium ovulaire, from ova persisting in the testis, giving large tumors with large cysts.

Bandler derived all ovarian teratomata from the Wolffian body, assuming that its cells are ectodermal, and capable of extensive types of metaplasia, but Bonnet disposes of this theory by showing that the Wolffian body is mesodermal and incapable of producing the ectodermal structures of teratomata. There is a certain convenience in thinking of the various testicular tumors, as their complexity increases, as arising from less and less differentiated cell groups. Thus one may assume that the most complex embryomata arise from early blastomeres, the bidermal teratomata from more differentiated cell groups involving two germinal layers, and the simpler tumors from simpler cell groups isolated much later in embryonal life from Wolffian body, Pfluger's tubes, gubernaculum testis, etc. Yet this scheme does not accord with the most prominent of observed facts. It is the great service of Wilms to have shown that these complex tumors are essentially tridermal and it is therefore a step backward to the hypothesis of origin from the Wolffian body or from any cell complex not containing all three embryonic layers. Even for the bidermal teratomata observed by Wilms, Recklinghausen, and others, and many apparently simple embryonal tumors of the testicle, the principle of the predominance of one element clears the way for the acceptance of one mode of origin for practically all the common testicular tumors.

6. *According to* Cavazanni teratomata arise in the sex glands from remnants of the Wolffian body or rather as Kossmann claims, from Müller's duct. He thinks there is a distinct difference in the etiology of the congenital embryomata appearing in early life and usually proving benign, and the embryoid malignant tumors of later life which usually follow trauma. Cavazanni described a bilobed teratoma of the testis in an infant of seven months. The upper lobe involved the epididymis, the lower lobe the testis. The two lobes contained different structures, the lower one arising from a cell complex capable of wide differentiation and giving rise also to the testicle, the upper lobe arising from a more differentiated cell group and giving rise to the tubules of the epididymis, i. e., from the mesonephric ducts. It could not have arisen, he thinks, in a single blastomere, nor in a fertilized polar body, nor in an ovum included in an embryo, but in cell complexes with much more limited potencies.

7. *Testicular tumors originating in adrenal rests.* The frequent occurrence of aberrant adrenal tissue about ovary and testis has been fully established by Marchand, Wiesel, and many others. Although widely separated in the adult, the primitive adrenal and the testis lie in immediate apposition in the early embryo. In the male these islands of aberrant tissue have been found chiefly along the spermatic cord, but they have not yet apparently been found in the body of the testis nor in the corpus Highmori. Debarnardi has described a tumor of the testis of which the structure strongly indicates its origin from adrenal tissue. Its exact point of origin, however, is not clear and it seems possible that it arose outside of the strict limits of the testicle. That adrenal tissue may appear in true teratomata is shown by one of Ohkubo's cases and in the writer's case 16, a teratoma testis in its second recurrence was indistinguishible from many adrenal tumors. Further evidence would therefore seem necessary to establish the occurrence of a true testicular tumor arising from pure adrenal tissue.

Conclusions Regarding the Origin of Teratoma Testis

That the circumstances surrounding the isolation of the originating cells of all testicu-

lar teratomata are identical we are perhaps not warranted in asserting. Many more facts of observation are required in support of such a claim. Yet the many cases in which apparently simple tumors of the testicle have on thorough examination proved to be complex, emphasizes the necessity of very complete study of a testicular tumor of embryonal type before it can be accepted as a pure simple tumor. Such observations steadily narrow the necessary scope and multiplicity of the theories of origin of these tumors. The cases described in this study support the view that all embryonal tumors of the testicle have an identical origin. Additional evidence of great value would be furnished by the discovery of very early stages of the tumors in question. No very early cases have yet been described, the writer's case 1 being perhaps as early as any yet obtained. The minute examination of a large number of embryonic testes might yield interesting or decisive data. I have failed to find anything of interest in a series of testicles of newborn infants sectioned chiefly through the corpus Highmori. Miss M. B. Kirkbride, in this laboratory, studied several thousand sections in series through the corpus Highmori and rete testis in twenty-five fœtuses. In this series were found several islands of chromaffine tissue near the rete, and two misplaced groups of stratified squamous epithelium. Apparently superfluous and misplaced cells of testicular tubules at the junction of testis and rete were frequently encountered. The occurrence of adrenal rests along the spermatic cord has been abundantly proven and Debarnardi has described a tumor probably arising from such a rest, but such cases are very rare. Huguenin found a group of stratified epithelial cells in the epididymis which might have given rise to a simple epidermoid.

The conflict of observation and opinion leads Borst to offer the following possibilities of origin for the embryonal tumors of the testicle.

(1) Cell groups may be isolated at any period of differentiation producing tumors containing single or related tissues.

(2) The embryogenic disturbance may affect several neighboring tissues giving rise to complex tumors.

(3) Sexual cells may develop into teratomata.

(4) True twinning of two embryos may give rise to bigerminal teratomata.

(1) Regarding the first of these propositions it is evident that the isolation of cell groups at different periods of differentiation is not required for, and cannot apply to, the large group of tridermal teratomata. Neither is it required for the bidermal growths, in which there is strong evidence of the suppression but not of the absence of the third germinal layer. The apparently simple embryonal tumors as rhabdomyoma, chondroma, sarcoma, and carcinoma, may be explained by Borst's theory but equally well by the principle of the predominance of one element of a teratoma. Theoretically there may be little choice between the two hypotheses but the facts of observation to which the present study contributes, are in the writer's opinion distinctly in favor of the latter view.

(2) That the embryogenic disturbance may affect several neighboring tissues is perhaps indicated by the observation of Cavazanni, who suggests a new point of view for the analysis of teratomata. Yet it is difficult to conceive of the nature and origin of such complex disturbances of normal growth and at present the facts of observation do not strongly support such an hypothesis.

(3) That sexual cells may develop into teratomata is an hypothesis which has two strong facts in its support, the predilection of teratomata for the sex organs and the development of abortive fœtal membranes or their analogues in many teratomata. These are facts of large caliber and it does not seem that the supporters of this theory, among which are Waldeyer and Ribbert, will soon be forced to abandon their position. The theory may apply equally well to the genital and to the extragenital teratomata, and it seems to be the only available explanation of the extragenital choriomata in male and female.

(4) True twinning of two embryos would

seem to have a very limited application in the field of testicular tumors.

Where such an event has occurred the result has been a much more orderly and complete reproduction of a parasitic individual than is seen in the most complex teratomata. This theory if it applies at all can refer only to very rare cases of implantations of parasitic fœtuses.

More recently Borst divides teratomata into three classes: (1) Extragenital teratomas, arising from totipotent material, the isolated blastomeres of Marchand-Bonnet. (2) Teratomas of the sex organs, arising from blastomeres possessing exclusively the sexual functions. (3) Teratomas derived from multipotent material of distinct regional stamp and producing the organs of these regions. The ground for this classification is the general feeling that no single embryogenic disturbance can account for all teratomas. That part of it which affects the teratomas of the sex organs supports the conclusions of the present study in so far as it admits that this group of tumors arises from sexual cells and not from somatic blastomeres.

Standing out prominently from the maze of speculation in this difficult field are two main facts of observation.

1. Teratoma testis arises almost invariably where the spermatic tubules enter the rete testis and where some sex cells must fail to realize their full development into spermatogonia. Here is one of those transitional areas where tumors are prone to develop from superfluous and isolated cells.

2. Teratoma testis arises at all ages, often after trauma, in testicles that appear to have been normal. The reasonable deduction is that all normal testicles contain the potential cells of origin of teratomata and that such rare accidents as isolation of blastomeres and fertilization of polar bodies are not concerned in their origin. It must be urged that no one has ever seen anything in the testicle which would directly connect teratomata with isolated blastomeres or polar bodies. The existence of such things in the testicle is purely hypothetical.

Influenced by these considerations the writer concludes from this study that teratoma testis arises from sex cells in the neighborhood of the rete, whose normal development into spermatogonia has been suppressed but whose potencies remain intact and ready to express themselves in the various forms of simple or complex teratomata.

Developing very rapidly these cells produce the common large cell tumors, possibly even the so-called lymphosarcomata of the testis. Increasing degrees of differentiation lead to the appearance of bidermal or tridermal growths, with predominance of one or another element, or eventually to the production of adult organs, as brain, bone, thyroid, etc., for all these potencies reside in the sex cell. Multiplication occurs at every stage of this differentiation, so that tridermal metastases may originate from the unfolding of tendencies retained by embolic tumor cells. According to this view these tumors are not derived from adult spermatogonia distributed throughout the testis, as held by Chevassu, but from more primitive sex cells in a very limited portion of the testis whose failure to realize their physiological development may be assumed to leave them especially susceptible to malignant tumor growth. Such cells of origin may be isolated spermatogonia which do not pass through the maturation division into primary spermatocyte and spermatid, but through some stimulus, as trauma or inflammation, begin at once to multiply without reduction of chromosomes, and thus develop into various tissues by the method of division of somatic cells.

There has been a growing tendency among recent writers to exclude the teratomas of the sex organs from the application of the Marchand-Bonnet theory. Thus Fischel, Ribbert, Fischer, A. Muller, Adami, and Borst all have concluded that this group of tumors arises from sexual cells or material and not from blastomeres isolated before the differentiation of the sex anlage. The writer believes that the cells of origin are far removed from blastomeres of any kind and are to be found in superfluous and immature sex cells from the group which normally develop spermatogonia. These tumors are therefore the offspring and not the brothers of the host.

That they are congenital or acquired, embryonal or adult, suggests that the cells of origin start to proliferate at different times, at different stages of maturity, and in different tempos, but not that the tumors arise from widely different embryogenic disturbances.

The belief in the genuine importance of trauma in the origin of these tumors is rendered more acceptable in the light of numerous observations in experimental morphology which show that the parthenogenetic development of frogs' eggs may readily be incited by trauma.

The conclusion drawn from the study of teratoma testis would seem to have important bearing on the origin of tumors in general. It seems very unlikely that the conditions surrounding the genesis of this group of tumors are wholly different from those prevailing with tumors in other organs, notwithstanding the fact that in the testis one has to deal with totipotent sex cells not occurring elsewhere. In the testis one encounters a wide variety of neoplasms, from the most undifferentiated, diffusely growing, highly malignant, round cell tumors, up to fully adult and harmless tissues and organs, all of which appear to have one and the same origin, the slow or rapid unfolding of original potencies of sex cells. These facts seem to the writer wholly irreconcilable with any relation to an external parasite, but reveal in a striking manner that most important of all facts known about the origin of neoplasms, that embryonal cells possess more than any others the essential factors in the inception of tumors.

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OSMOSIS AS AN IMPORTANT FACTOR IN THE ACTION OF ANTISEPTICS[1]

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NOTE.—This paper is an unaltered copy of the manuscript, as presented to the Western Surgical Association. The objective point being merely the enunciation of a principle of important clinical significance, it seemed the wise course not to fog the issue, either by a discursive argument regarding the moot points in the physics and physiology of osmosis, or by presenting, in prolix detail, tabulated laboratory experiments, before a clinical association.

We feel that, even at the risk of being charged with incompleteness of presentation, it is better to omit from the published article a critique on the voluminous and highly technical literature of osmosis. In lieu of such a critique a few references are furnished, which contain practically all the significant data known, concerning osmosis. The article by Pfeffer (5) is admirably complete up to 1877, and is supplemented by the work of Macallum (6), Kahlenberg (7), Livingston (8), Botazzi (9), and Zangger (10) who bring the subject down to date both as regards original observations and by way of complete bibliographies. Macallum's Harvey Lecture, and his address to the Physiological Section of the British Association for the Advancement of Science, and Kahlenberg's exceptionally clear exposition, must be especially commended. Hoeber's (11) treatise furnishes an almost essential basis for many phases of the problem. The work of Overton (12) emphasizes the important practical interrelationship between clinical medicine and various phases of the problem of osmosis.

We append a list of our experimental data, in order that it may be accessible for confirmation or negation.

IT is interesting to note that in the evolution of medical science, certain facts become established as so-called principles. Such establishment rests on the basis of incontestable clinical evidence, or on the basis of experimental induction that has been confirmed beyond all reasonable doubt. A very natural and healthy skepticism often delays the adoption of a principle, until an overwhelming amount of proof has accumulated. This seems to be the case as regards the use in surgery, of many of the so-called germicides. Despite the numerous contributions to literature concerning the inefficacy of such a drug, for example, as bichloride of mercury, it still remains a formal adjunct to most operating rooms.

The aim of this paper is not so much to demonstrate the inefficiency of certain supposedly germicidal solutions, as it is to determine the underlying factor that makes a solution an effectual germicide. Up to the present time the various experimental methods used for testing out the strength of germicides have been faulty in the extreme, in so far as they have failed to reproduce the actual conditions which confront surgeons. Post and Nicholl (1) have stated these methods of testing germicidal power as follows:

1. Thread method of Koch: bacteria dried on threads, which are suspended in the germicides to be tested.

2. Garnet method: Emulsions of bacteria dried on garnets, which are immersed in the germicidal solutions.

3. Drop method: A known small quantity of broth culture of a definite species of bacteria is added to a constant volume of germicidal solution.

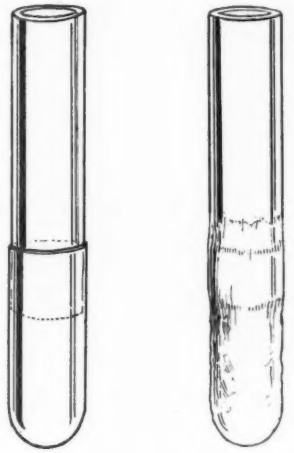
After showing that all these test methods are faulty, Post and Nicholl state their own method of plating out from a known quantity of germicidal solution, to which a definite measure of an emulsion of bacteria had been added. Unfortunately in the human organism, bacteria do not occur in a state of acrobatic suspension on strings; they are not often, even in our better class of patients, found adherent to garnets, and rarely are they found under such conditions as to enable us to so effectually bathe them in a solution as does the method of Post and Nicholl, or the drop method.

A point of absolutely vital importance in any consideration dealing with the artificial destruction of bacteria is the fact that these organisms are not always found free on the body or on wound surfaces, but occur also

[1] Read before the Western Surgical Association, December 19, 1910.

in the deeper layers of the skin and tissues, or covered over by blood or exudate. Furthermore the bacteria themselves have a more or less resistant exterior that serves as a protective armor for their vital protoplasm. It is clear, therefore, that a germicidal solution can be thoroughly effectual in the surgical sense, in the practical sense, only if it possesses the power of penetration. Our problem is identically the same as the one which confronts our ordnance experts. The efficiency of a projectile depends almost entirely on the driving force back of it; whatever other excellent qualifications it may possess, it is useless as a destructive agency, unless it possesses the power of plowing through armor protection. And just so with a germicide. The results consequent upon catching a bacterium, fixing him on a string, and drowning him in an ocean of antiseptic, are in no sense of the word a measure of surgical efficiency. Our germicide must possess, in addition to the inherent power of killing, the property of reaching the bacteria by penetrating the tissues in which they lie.

This power to penetrate is none other than the physical and physiological process known as osmosis, and the task we set for ourselves was the determination of the relationship existing between osmotic power and germicidal efficiency. The work really had its genesis in a clinical observation. For a year one of us was plagued by a distressing furunculosis. All the known varieties of wet packs were used with the result that after a painful siege, each furuncle eventually came to incision. Finally, a pack of 95 per cent alcohol was tried, with the result that in every case, when used early enough, the furuncle was aborted. Further extended experience with punctured wounds and abrasions gave the same results. (The pack was saturated with alcohol and resaturated as soon as it dried; under no circumstances was or should a rubber protective covering be used.) The alcohol certainly did what other much vaunted germicides failed to do. The most rational explanation of the result attained was that the alcohol reached and destroyed the focus by penetrating into the deeper layers of the skin.



A B

Fig. 1. A. One half of gelatine capsule fitted on end of glass tube. B. The capsule and lower end of the tube have been dipped in celloidin; after the celloidin has hardened, the gelatine capsule is dissolved out with warm water, leaving a thin celloidin bag.

In our experimental work, we studied the comparative efficiency of germicidal solutions from the point of view of their osmotic power through animal and celloidin membranes. As animal membranes, we used mesentery, omentum, diaphragm, and skin; some of these membranes were used while still alive, others after removal from the body of the animal. We used celloidin membrane because it offered a particularly convenient and excellently controllable method. These celloidin test tube capsules, made by a modification of the method of Harris (2), clearly illustrate our technique with celloidin membranes (see Fig. 1). The capsules were filled with broth cultures of various bacteria,[1] and then immersed in various watery solutions of antiseptics, such as carbolic acid, bichloride, crysillic acid, and lysol. At intervals varying from 10 minutes to 24 hours, a loopful of the various cultures was removed from the capsules and plated. With the exception of one watery antiseptic, the germs were unaffected, even after as long a period

[1] We found it very practical to use typhoid bacilli in all instances, because the time necessary to produce sluggishness of motion and finally cessation of motility were very suggestive phenomena which we could determine and study during the course of the experiment, without waiting for the results of plating.

as 24 hours. This one exception was iodine. When iodine was dissolved to a strength of 12½ per cent in water and potassium iodide, it sterilized the germ content of the capsule in twenty-five minutes; furthermore, by the starch reaction, we could determine that the iodine had penetrated through the celloidin into the broth culture. After three-quarters of an hour it penetrated in sufficient quantity to color the broth a walnut brown.

The next series of experiments dealt with alcohol. We used alcohol (grain alcohol) of varying strengths from 99 per cent to 50 per cent. The results were little short of astonishing. The higher strengths alcohol penetrated the capsule with striking rapidity. Above 94 per cent of the contents the capsules were sterilized in from three to ten minutes. Eighty per cent alcohol worked much slower, 70 per cent took 7½ hours to kill the organisms, and 50 per cent had no apparent effect after 24 hours. These results are in accord with our personal clinical experience and also in accord with some lately published clinical reports from the medical department of the Prussian army (3). They stand out in marked contrast to the formerly credited doctrine that 50 per cent to 70 per cent alcohol was the most efficient antiseptic, a doctrine whose incorrectness depends entirely upon faulty deduction from laboratory data. Although we varied the details of this set of experiments in a half a dozen different ways, we always secured the same result, namely, that the germicidal power of alcohol varied directly as its percentage strength. It is interesting to note, however, that the higher we ascended in the scale of concentration of alcohol, the less marked was the difference in bactericidal power. In other words, 95 per cent alcohol was much more effectual than 80 per cent alcohol, whereas 99 per cent was not perceptibly more efficient than 95 per cent.

Having ascertained thus the behavior of watery solution and of varying alcohol strengths on bacteria enclosed in a celloidin chamber, our next series of experiments were directed toward ascertaining whether the action of alcohol was intensified by dissolving germicidal drugs in it, such drugs, for example, as bichloride, carbolic, Harrington's solution, and iodine. Here again we encountered some unexpected results. In the first place we found that with one exception, namely, iodine, the unadulterated alcohol acted as rapidly and efficiently as did the alcoholic solution of germicides. Further than this we found that if in making up the solution, the alcohol was diluted, its action was not only not heightened but actually lessened. Harrington's solution, for example, represents a 60 per cent dilution of alcohol, and it took the same time to kill the organisms despite its percentage of hydrochloric acid and bichloride of mercury, as did plain 60 per cent alcohol. The alcoholic solution of iodine sterilized the organisms more rapidly than did the highest strengths of plain alcohol. This is a fact of striking interest, for two reasons: (1) It confirms recent clinical experience regarding the efficiency of tincture iodine and (2) it possibly signifies that by combining two substances with high osmotic power we secure a solution of higher osmotic power than that possessed by either substance acting alone. We found that by raising or lowering the percentage of alcohol or by raising or lowering the percentage of iodine in the solution, we could proportionately heighten or diminish the germicidal power. After from three to five minutes a loopful of the broth removed from the celloidin capsule invariably gave the starch reaction for free iodine. When strong, plain alcohol was used, we could always determine that it has penetrated the capsule and entered the broth by the rapidity with which a loopful of broth would evaporate, when transferred to a clean glass slide.

Here then was a set of experiments, suggestive to say the least, in that they upset a few well founded ideas fairly effectually, and also in that they suggested the conclusion that osmotic power is a force of prime importance in determining the efficacy of antiseptics. To have forthwith adopted this conclusion, however, and to have grafted our results bodily onto clinical data, would have been only another example of laboratory autocracy. In the ontogeny, and for that matter in the whole phylogeny of all varieties

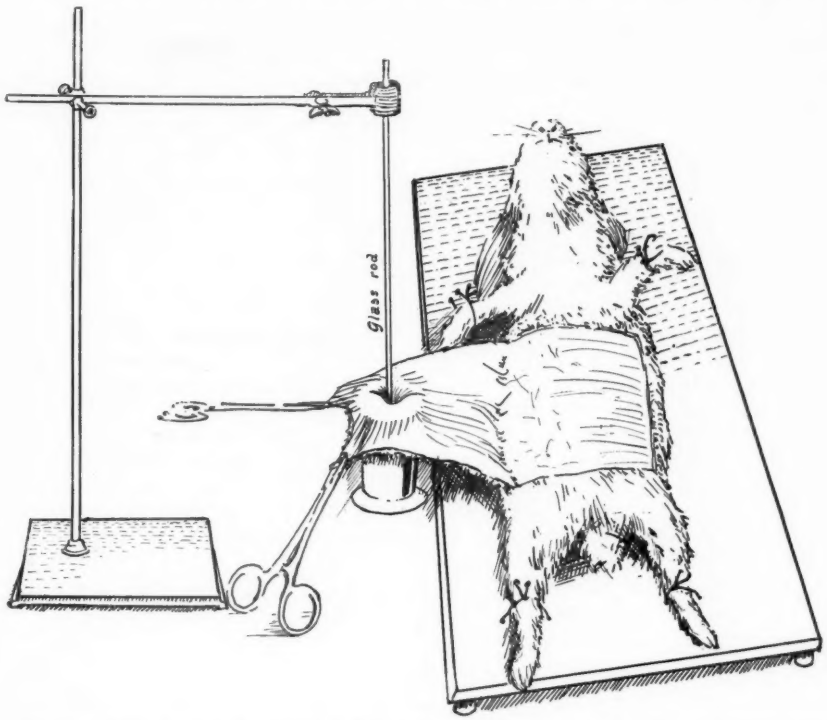


Fig. 2. Illustrating the method of utilizing a flap of live rabbit's skin as a membrane in osmosis experiments.

of animal life, a celloidin membrane is as foreign a material as is a dried thread.

Our next line of attack, therefore, was on animal membranes. The method of procedure was very simple. A small salt cellar was filled with the germicidal solution to be tested, and then a flap of skin (still alive and attached to the animal) was laid over the salt cellar in such fashion as to pouch into the fluid (see Fig. 2). The same procedure was carried out with live mesentery, and live omentum. Into the pouch which was bathed, on one side, by the fluid to be tested, was put a measured quantity of a broth culture of bacteria. Thus we had, so to speak, a living osmometer. The diaphragm of a rabbit makes an excellent animal membrane but, of course, we could not use the diaphragm while still in connection with the living animal. This animal experimentation, with but few exceptions, tallied with the results previously secured with celloidin. Alcohol penetrated and was effectual as a germicide in direct proportion to its percentage strength. We succeeded in determining that it even penetrated the hidelike skin of the rabbit. Tincture of iodine penetrated and killed even more rapidly than did strong alcohol. Indeed, in the experiments with the delicate thin mesentery, the penetration of the iodine was so rapid, that the broth was colored brown before we had time to reach for a platinum loop with which to extract a drop of it. Watery solution of bichloride in the strength of 1-5000 was totally ineffectual with all membranes, although a 1-1000 solution penetrated mesentery and destroyed the germ contents in 45 minutes. We encountered just one marked discrepancy: Five per cent carbolic acid in water effectually penetrated a membrane of diaphragm of a rabbit in three minutes, whereas, it will be

remembered that this same strength of carbolic acid totally failed to influence organisms enclosed in a celloidin capsule. The penetration of animal membrane by watery solution of carbolic acid ought really to have been expected on pure a priori grounds, knowing as we do how readily carbolic acid may be recovered in the urine after extensive skin applications of this drug.

As is well known, authorities are gradually veering to the point of view that the field of operation is best prepared by the simple application of tincture of iodine, or by bathing it in alcohol, without preliminary washing with soap and water. The reasons commonly assigned for this simplified method are that washing the skin with water swells the epidermis, thus imprisoning the bacteria; or that the water softens the epidermis so that it desquamates and easily brushes off during operative manipulations, or that the excess of water dilutes the alcohol used subsequently. The fact that water used immediately before the alcohol is prejudicial to thorough sterilization, we confirmed by our experiments; but we proved, we think, that the reasons assigned therefor are faulty. It is a fairly well established principle in osmosis, that the process goes on best when the fluid on one side of the membrane is thoroughly soluble in the membrane. Now alcohol is soluble in the fatty constituents of the cell, and the more of this fat there is present, the more complete is the osmotic phenomenon. This observation was made and lost sight of as early as 1855, by Lhermite (4). We repeated Lhermite's experiments and found that by rubbing a rabbit's skin with castor oil we could hasten markedly the passage of alcohol through it. Preliminary washing of the skin is to be discredited then, solely for the reason that it removes the natural oily constituents and not because of any swelling or softening effect on the epidermis.

We might detail innumerable clinical deductions, concerning such facts as the effect of alcohol on clean wounds, its vagaries of action depending on whether it is imprisoned under an impervious cover, or allowed to evaporate freely, its use regionally, its fixing and hardening properties, etc.; but that would go beyond our purpose of attempting merely to establish the surgical principle of osmosis as a factor in the action of antiseptics. There are only a few words of caution necessary before closing. We realize fully that in dealing with the problem of osmosis, we have in hand a set of phenomena, the fundamental basis of which has eluded all attempts at explanation by our best physicists and physiologists. We know that every variety of human tissue will react differently as an osmotic membrane, and that it is beyond our humble power to set to rights the complex, seemingly contradictory phenomena. We do not feel that this is either the time or place to go into these questions; but we certainly do feel the necessity of correlating more closely than has been done heretofore the vital phenomena of osmosis with both surgical science and art.

EXPERIMENT 1

Effect of varying strengths of alcohol on typhoid bacilli in celloidin capsules.

Time	99.8%	95%	80%	70%	50%
3 min.	slight motil	slight motil	motil	motil	motil
6 min.	non-motil	non-motil	motil	motil	motil
10 min.	non-motil	non-motil	motil	motil	motil
15 min.	non-motil	non-motil	motil	motil	motil
30 min.	non-motil	non-motil	motil	motil	motil
1 hr.	non-motil	non-motil	motil	motil	motil
18 hrs.	non-motil	non-motil	non-motil	non-motil	motil

Result of plating: All the motil specimens gave a good growth, and all non-motil ones were sterile.

EXPERIMENT 2

Effect of alcoholic solutions (95%) of antiseptics on typhoid culture in celloidin capsules (very thick capsules).

Time	Alcohol 95%	Harrington	Tinc. iodine	5% carbol. in alcohol
2 min.	motil	motil	motil	motil
8 min.	motil	motil	non-motil	motil
15 min.	motil	motil	non-motil	motil
25 min.	non-motil	motil	non-motil	non-motil

Result of plating: All showing non-motil were sterile.

EXPERIMENT 3

Effect of varying strengths alcohol on staphylococcus culture in celloidin capsules. + = growth, − = sterility.

Time	95%	80%	70%	50%	Time	95%	80%	70%	50%
5 min.	+	+	+	+	1 hr.	−	+	+	+
10 min.	+	+	+	+	1½ hrs.	−	−	+	+
20 min.	+	+	+	+	2 hrs.	−	−	+	+
30 min.	−	+	+	+	18 hrs.	−	−	−	+

EXPERIMENT 4

Same as above, using colon instead of staphylococcus.

Time	95%	80%	70%	50%	Time	95%	80%	70%	50%
5 min.	+	+	+	+	1 hr.	−	−	+	+
10 min.	+	+	+	+	1½ hrs.	−	−	+	+
20 min.	−	+	+	+	2 hrs.	−	−	+	+
30 min.	−	+	+	+	18 hrs.	−	−	−	+

EXPERIMENT 5

Effect of alcoholic and watery solution of antiseptics on broth culture of typhoid bacilli in celloidin capsules.

Time	95% alcohol	70% alcohol	5% carbol. acid in water	2% Cry-sillic acid in water	1-1000 $HgCl_2$ in water
10 min.	motil	motil	motil	motil	motil
20 min.	non-motil	motil	motil	motil	motil
30 min.	non-motil	motil	motil	motil	motil
24 hrs.	non-motil	non-motil	motil	motil	motil

Result of plating: No growth from the capsules in 95% alcohol after 20 minutes, and in the 70% at end of 24 hrs., but growth from all the others.

EXPERIMENT 6

Broth culture of typhoid as above, in capsules immersed in *alcoholic* (95%) solutions of antiseptics.

Time	95% alcohol	7½% iodine in 95% alcohol	1-1000 $HgCl_2$ in 95% alcohol	5% carbolic in 95% alcohol	5% thymol in 95% alcohol
3 min.	motil	motil	motil	motil	motil
5 min.	motil	motil	motil	motil	motil
10 min.	sluggish?	non-motil	non-motil	non-motil	sluggish?
15 min.	non-motil	non-motil	non-motil	non-motil	non-motil

Result of plating: Growth up to ten minutes in all capsules; after 10 minutes, no growth.

EXPERIMENT 7

Effect of 70% alcohol on staph., colon, and typhoid in celloidin capsules. + = growth, − = sterility.

Time	Staph.	Colon	Typh.
1½ hrs.	+	+	+
3 hrs.	+	+	+
4½ hrs.	+	+	+
6 hrs.	+	+	+
7½ hrs.	−	+	−
8½ hrs.	−	+	−

EXPERIMENT 8

Effect of *watery* solutions of antiseptics on staph., colon, and typhoid in celloidin capsules. + = growth, − = sterility.

Time	Germ	5% Carbol.	1-1000 $HgCl_2$	Lugol
20 min.	Staph.	+	+	+
	Colon	+	+	+
	Typh.	+	+	+
30 min.	Staph.	+	+	+
	Colon	+	+	+
	Typh.	+	+	+
1 hr.	Staph.	+	+	+
	Colon	+	+	+
	Typh.	+	+	+
2 hrs.	Staph.	+	+	+
	Colon	+	+	+
	Typh.	+	+	+
24 hrs.	Staph.	−	+	+
	Colon	−	+	+
	Typh.	−	+	+

EXPERIMENT 9

To show action of varying strengths of iodine in *watery* solution, on colon culture in celloidin capsules.

Appearance of starch reaction in the broth indicated by X.

Time	25% I in 50% KI	12½% I in 50% KI	5% I in 50% KI
6 min.	+	+	+
10 min.	+	+	+
15 min.	+	+	+
20 min.	−X	+	+
25 min.	−	−X	+
35 min.	−	−	+
45 min.	−	−	+

EXPERIMENT 10

Contrast of the action of some *alcoholic* (95%) solutions of antiseptics and a strong *watery* solution of iodine on staphylococci and colon in celloidin capsules. + = growth, − = sterility.

Time	Germ	95% alcohol	Harrington	Tinc. iodine	5% Carbol. in 95% alc.	1-1000 HgCl in 95% alc.	Sat. sol. iodine in 5% KI
10 min.	Staph.	+	+	+	+	+	+
	Colon	+	+	+	+	+	+
20 min.	Staph.	+	+	−	+	+	+
	Colon	+	+	−	+	+	+
30 min.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	+	+
40 min.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	−	+
50 min.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	−	+
1 hr.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	−	+
1½ hrs.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	−	+
2 hrs.	Staph.	−	+	−	−	−	+
	Colon	−	+	−	−	−	+

EXPERIMENT 11

To show influence of thickness of capsule. Thick capsules made by dipping three times in celloidin; thin ones by dipping once. Colon bacillus culture used. + = growth, — = sterility.

Time	95% alcohol		Tinct. iodine	
	Thick capsule	Thin capsule	Thick capsule	Thin capsule
5 min.	+	+	+	+
10 min.	+	+	+	−
15 min.	+	+	+	−
20 min.	+	+	+	−
25 min.	+	−	−	−

EXPERIMENT 12

To show action of higher concentrations of alcohol and iodine on colon bacillus culture in celloidin capsules.

This experiment also shows that small percentage variation (95% to 98%) makes no perceptible difference.

Time	14% iodine in 98% alc.	14% iodine in 95% alc.	7% iodine in 98% alc	7% iodine in 95% alc.	98% alc.	95% alc.
2 min.	+	+	+	+	+	+
4 min.	−	−	+	+	+	+
6 min.	−	−	−	−	+	+
8 min.	−	−	−	−	−	−
10 min.	−	−	−	−	−	−

EXPERIMENT 13

Effect of alcohol (95%) on typhoid bacilli in a pouch of living rabbit omentum.

Time	95% alcohol.
1 min.	motil
3 min.	non-motil
5 min.	non-motil

Result of plating: No growth after three minutes.

EXPERIMENT 14

Effect of alcohol (95%) on typhoid bacilli in a pouch of living rabbit skin (fur side in the alcohol).

Time	95% alcohol.
3 min.	active motil
5 min.	less motil
10 min.	loss of motion

Not plated out.

EXPERIMENT 15

Typhoid bacilli, with living rabbit skin, omentum and mesentery as membranes, and 1-1000 $HgCl_2$ in H_2O, and 95% alcohol as solutions.

Time	Skin 1-1000 $HgCl_2$ in H_2O	Mesentery 95% alc.	Omentum 1-1000 $HgCl_2$ in H_2O
3 min.	motil	motil	motil
10 min.	motil	non-motil	motil
15 min.	motil	non-motil	motil

Result of plating: Growth in all except 10 and 15 minute mesentery.

EXPERIMENT 16

Effect of alcohol (95%) on typhoid culture enclosed in membrane of living rabbit skin. (Old rabbit, very thick skin, histologically denser than previous skins).

Time	95% alcohol
3 min.	motil
10 min.	motil
15 min.	less motil
20 min.	slight motil
37 min.	very little motil
55 min.	non-motil

Result of plating: Growth in the 55 min. specimen.

EXPERIMENT 17

Effect of alcohol (95%) on hay bacillus in membrane of living rabbit skin.

Experiment allowed to run 1½ hours. Plating showed growth at end of this time, but the last plating showed much smaller number of colonies than earlier platings.

EXPERIMENT 18

To determine time necessary for iodine to penetrate omentum and skin. Time determined by appearance of starch reaction. Emaciated rabbit with very thin skin.

Time	Omentum tinct. iodine	Omentum lugol sol.	Skin tinct. iodine
1 min.	starch reaction	no reaction	no reaction
3 min.	starch reaction	no reaction	no reaction
5 min.	starch reaction	starch reaction	no reaction
30 min.	starch reaction	starch reaction	no reaction
1 hr.	starch reaction	starch reaction	starch reaction

Note.—In all other iodine experiments we were unable to produce starch reaction in one hour, when skin was used as membrane.

EXPERIMENT 19

To show comparative efficiency of alcohol (95%) and tinc. iodine through mesentery of guinea pig. Experiments carried on simultaneously on two different portions of mesentery. Typhoid culture.

Time	Alcohol	Tinc. iodine
3 min.	motil	non-motil
6 min.	non-motil	non-motil
10 min.	non-motil	non-motil
15 min.	non-motil	non-motil

Result of plating: All sterile except 3 min., 95% alcohol. Starch reaction after one minute.

EXPERIMENT 20

To show penetration of $HgCl_2$ in water through rabbit's diaphragm (immediately after removal from body), and through live rabbit's mesentery.

Time	Diaphragm 1-1000 $HgCl_2$ in H_2O	Diaphragm 1-5000 $HgCl_2$ in H_2O	Mesentery 1-1000 $HgCl_2$ in H_2O
30 min.	motil	motil	motil
1 hr.	motil	motil	non-motil
2 hrs.	motil	motil	non-motil

Result of plating: Growth in all except mesentery after 1 hour.

EXPERIMENT 21

To show effect of carbolic acid (watery solution) on typhoid, through membrane of rabbit's diaphragm.

Time	3% carbol.	5% carbol.
2 min.	motil	motil
3 min.	motil	non-motil
6 min.	non-motil	non-motil

Result of plating: All showing non-motil were sterile.

EXPERIMENT 22

To show effect of oil on time penetration of alcohol. Two flaps of skin were dissected off the abdomen (with pedicle attachment) and pouched into salt cellar of 95% alcohol. One flap was thoroughly rubbed with castor oil and the other one untouched. Into the pouch of skin was placed broth culture of typhoid.

Time	Side not oiled	Side oiled
5 min.	motil	motil
10 min.	motil	motil
30 min.	less motil	less motil
1 hr.	less motil	non-motil
1½ hrs.	less motil	non-motil
2 hrs.	non-motil	non-motil
2¾ hrs.	non-motil	non-motil

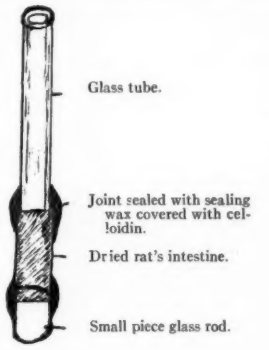
Result of plating: Growth in all, in spite of loss of motion.

EXPERIMENT 23

To determine, by evaporation time, the influence of oil on the rapidity of penetration of alcohol.

Details of experiment exactly as above. At the end of 30 minutes a platinum loop full of broth from the oiled side, from the non-oiled side, and a loop full of broth from a test tube (control broth) were placed on a clean glass slide, and the time required for complete evaporation noted. A second trial was made at end of fifty minutes.

	1st trial seconds	2d trial seconds
Drop from oiled side evaporated in	105	84
Drop from non-oiled side evaporated in	135	90
Drop from control broth evaporated in	160	158



EXPERIMENT 24

Effect of alcohol on typhoid bacilli enclosed in *dried* animal membrane made of rat's intestine.

After 18 hours in 99% and 95% alcohol the bacilli were actively motil, and gave a good growth on plating.

The intestine was inflated and then dried in an air current for a few hours, until it was crisp.

Note.—The failure of the alcohol to penetrate this dried animal membrane can hardly be attributed to absence of fat, for the drying process was not sufficiently prolonged to dry out the fat.

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HERNIAL TUBERCULOSIS[1]

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HERNIAL tuberculosis is said to be rare. While searching through the literature, one is impressed by the fact that there is an increase in the number of cases reported shortly after a publication on this topic.

Considering the frequency of peritoneal tuberculosis, one is rather puzzled that the hernial sac, merely a diverticulum of the peritoneum, should be so seldom involved by tuberculosis. There is no doubt that a large number of cases is overlooked, the probable reason being that the gross appearance of the sac is not always typical of tuberculosis, making the macroscopic diagnosis difficult; also that hernial sacs are not sectioned as a routine work for histopathologic diagnosis; furthermore, because the fibrous type of tuberculosis is merely interpreted as an evidence of inflammatory processes due to trauma.

The first case of tuberculous hernia was apparently mentioned by John Baron in 1818. A second case was reported by Pitha in 1845. The possibility of a tuberculous process involving the hernial structures is alluded to by Boursier in his classical article on hernia in the Dictionnaire Encyclopédique des Sciences médicales, 1888, vol. xiii, part 2. The first actual emphasis was made by Cruvelhier who in his traité d'anatomie pathologique (1862) describes three cases of tuberculous hernia. Hayem reported in 1871 at the societé anatomique of Paris a case of Reverdin. Brissaud observed a case which figured later in Hanot's thesis (1883). Up to 1889 there were only seven cases reported published by Léjars in his work on hernial neoplasms. In 1891, Jonnesco added three cases from the literature and one from the service of his chief, Le Dentu, of the hospital St. Louis, of Paris. Cotte who wrote the most extensive and perhaps the most thorough article on the subject, collected in 1906, 136 cases. In this country E. Wyllys Andrews reported two cases in the Annals of Surgery in 1901. B. W. Coley relates three personal cases in Keen's Surgery, vol. iv. Mitchell, of Baltimore, published an article on this subject. A number of investigators have made subsequent reports, the majority French writers, to whom belongs the credit for the accurate and detailed study of this condition.

Tuberculous hernia is most common in children. In Abel's series of forty-five cases there were twenty-six children. Cotte in an analysis of 121 cases, in which the ages were stated, found:

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46 cases under 10 years of age.
22 cases between the ages of 10 and 20.
31 cases between the ages of 20 and 40.
22 cases above 40.

The youngest patient was that of Antonelli, 6 weeks old. The patient of Nurdin was 21 months old. Albertin and Broca found tuberculous hernias in children two years old. Petit had several cases in children three years of age. The patients of Santucci and Lewisohn were over 60.

The male is affected three times as often as the female for the sole reason that hernia is more frequent in the former. The relative frequency of tuberculous hernia as compared with non-tuberculous ones is indicated by the following figures: In Italy Velo found 8 cases among 800 radical cures for hernia; Sardino, 5 in 100 cases; Remedi, 4 in 338 cases; Cavazzani, 4 in 1,000 cases. In France, Broca found 15 cases in his children's clinic among 900 radical cures for hernia. In Germany, Hilgenreiner found three cases among 717 herniotomies in Wölfler's clinic.

The type of hernia is given in Cotte's table as follows:

Inguinal, 87 cases; femoral, 11 cases; umbilical, 3 cases. In sixteen cases the inguinal hernia was double; once there was a bilateral femoral hernia (Tscherning), and once the patient had a right inguinal and a left femoral hernia (Dandolo).

The cause of hernial tuberculosis is largely that of peritoneal and intestinal tuberculosis. The starting point may be the intestine, peritoneum, mesenteric lymph nodes, lungs, genitalia, bones, the infection traveling both by the lymph and blood stream. In an analysis of 48 cases there was no tuberculous history in 16 cases; in the remainder of thirty-two, there was a history of tuberculosis of one or another organ. According to Haegler the infection may originate (a) from the mesenteric lymph nodes, (b) from the intestinal wall, (c) from the pleura, the bacilli traveling through the diaphragm. The genitalia, particularly in the female, are a common source of infection (Lindner). The susceptibility of the hernial sac to tuberculosis is explained by Charpy by the suitable blood supply. The circulation in the sac is midway between that of hypo-and hypervascular tissues, which is just the type of tissue the tubercule bacilli like. We know that in pulmonary tuberculosis the bacilli have a predilection for the apex because of its poorer blood supply. In a similar manner, tubercle bacilli are retained in intestinal loops with circulatory stasis. Jonnesco considers the following causes of etiologic moment: (a) Mechanical insult by truss, etc., diminishing the resistance of tissues. (b) Constriction at the neck of the sac producing a circulatory stasis in the sac and contents. (c) Pre-existing inflammatory peritonitis (peritonitis herniosa), a phenomenon often observed and described by many writers, such as Hayward, Dupley, Richet, Trélat, LeFort. In a number of cases the hernial sac became tuberculous from a primarily tuberculous loop of intestine. König found among 107 cases of tuberculous peritonitis 80 cases of intestinal tuberculosis, or 74 per cent, and expresses the belief that a great percentage of cases of tuberculous peritonitis are secondary to intestinal tuberculosis. In some cases the sac alone is tuberculous. This, however, does not exclude possibility of a pre-existing tuberculous process in the normal appearing intestine. Dobroklonski has shown that tubercle bacilli can pass through the intestines without producing any visible pathologic changes in the wall.

As to whether tuberculous hernia is primary or secondary to peritoneal tuberculosis the opinions are divided. The primary school has its exponent in Jonnesco and partisans in Léjars, Sternberg, Haegler, Southam. [In the words of Léjars "la péritonite tuberculeuse herniare est une péritonite entièrèment locale."]

Von Bruns holds the opposite view, the majority of writers, such as Tenderich, Justian, Roth, Schmidt, Ziemsen, Garré, supporting it. The polemic of this question is rather extensive. The consensus of opinion, however, seems to be that in 70 per cent of the cases it is merely the expression of a peritoneal tuberculosis and that in the remainder of the cases it is associated with tuberculosis of other organs, genitalia in particular. True enough, there are a few cases in which this

process seems, apparently, to be the only tuberculous lesion the individual had. After all the terms primary and secondary are very elastic. From a practical standpoint we can say that an organ is involved primarily by tuberculosis when we cannot demonstrate clinically or otherwise any other focus. However, we must not forget that minute tuberculous lesions can be present in the body which may be overlooked even at the post-mortem. Pansini, Spengler, Kossel, showed that lymph nodes normal in appearance may contain tubercle bacilli. Cornet found latent foci of tuberculosis in four out of ten children dead from diphtheria, all of whom showed no clinical evidence of tuberculosis during life.

The scarcity of tubercles toward the neck of the hernial sac and their preponderance — in the lower part was given by the primary school as an argument against transmission of tuberculosis from the peritoneum. As was shown by Rindfleisch, however, tubercle bacilli prefer dependent portions of tissues, folds, diverticula, so that in their descent from the peritoneum they may have avoided the neck of the sac and involved the lower portion. The absence of any relationship between a hernia and a tuberculous process of the peritoneum was shown by Albert, who cites two cases of tuberculous peritonitis in which the associated hernia was non-tuberculous. Hernial tuberculosis is frequently associated with genital tuberculosis. Among 113 cases, 23, or 20 per cent, had genital tuberculosis. In the cases of Puech, Broca, Muscatello, there was either a tuberculous ovary or tube in the sac. Tuberculous hernia was associated with tuberculous epididymis, or cord in the case of Bruns, Southam, Broca. Pulmonary tuberculosis was present in 14 per cent of cases. Tuberculosis may occur in a recent or an old hernia, although no one can establish the exact age of a hernia. W. Roser of Marburg showed in 1889 in his work on the origin of hernias that the hernial sac antedates its clinical appearance by weeks, months, or years. Abel believes that some tuberculous hernias of recent date are due to the pouching of the peritoneum from the pressure of ascitic fluid associated with peritoneal tuberculosis.

Pathological anatomy. All the parts of a hernia can be invaded by tuberculosis, sac, and contents. Tuberculosis of the sac alone is common in children, rare in adults. According to Nurdin the sac alone was tuberculous in 11 out of 16 children. Isolated tuberculosis of the sac was reported by Cruvelhier, Hayem, Reverdin, but the viscus contained in the sac was not examined in these cases. As a rule both sac and contents are tuberculous. Among 126 cases, where the facts were recorded, the sac alone was involved in 68 cases, the sac and contents in 52 cases, while in 6 cases only the contents were tuberculous, the sac being normal. These figures may be misleading because the viscus contained in the sac may have receded on the operating table and the surgeon may not have had the opportunity to examine it, as is often the case.

A. Tuberculosis of the sac. The process may involve a part of or the entire sac. It may manifest itself in one of three forms: (a) miliary, (b) ulcero-or fibrocaseous, (c) purely fibrous. The miliary form is the most common. The sac may be covered with isolated or confluent tubercles. It usually contains fluid, ascitic in character, occasionally cloudy or sanguinolent. The fluid is a part of the peritoneal ascitis and flows freely when pressing upon the abdomen.

B. In the ulcerocaseous form, the inner surface of the sac is covered with false membranes of yellowish color or with tubercles in a state of caseation. Occasionally, there is one or more tuberculous abscesses between the sac and intestinal wall. The fibrous form is rare. It may occur as such from the onset or it may follow one or the other types. It is an evidence of cicatrization, a definite attempt at healing. The sac is usually adherent to the omentum, a nodule being present at the point of adhesion. In the case of Hayem, fibrous bands crossed each other in various directions, forming a sponge-like structure, the cavities communicating with one another. In Andrews' case, the omentum was adherent to the sac, both being covered with fibrous nodules. Adhesions may strangulate the neck of the sac, converting it into a cyst (Cruvellier, Cachau, Vallas, and Leriche).

Visceral lesions. The sac may contain intestines, omentum, or genital organs. The intestine may show any of the three forms of tuberculosis. Cold abscesses may form between the loops of intestines (Roth, Jordan). The ulcerocaseous form may perforate and produce a tuberculous peritonitis, as it happened in a case observed by Tenderich. In a patient reported by Jaboulay and Patel, a pyostercoral fistula resulted from the perforation of a tuberculous ulceration. The fibrous type is rather rare.

The omentum may be studded with small granulations or it may be adherent to the sac, the adhesion being either partial or complete. In the case of Cotte and Petit, the omentum had the appearance of a lipoma and did not suggest its real nature until disclosed by the microscope. In a case of Cruvelhier, the mesentery of a herniated loop of intestine was tuberculous, the sac being normal.

Genitalia. Broca found a tuberculous tube in a girl six years of age. Muscatello met with a tuberculous pyosalpinx in the sac of an inguinal hernia. Puech found a tuberculous ovary in the sac. In the male the hernial sac may contain a tuberculous vas or epididymis.

Histologically, tuberculosis of the hernial sac resembles tuberculosis of other serous membranes. In a large number of cases the histologic picture was the only means of making a diagnosis.

Cachau, Colzi, Broca, were able to produce tuberculosis in guinea pigs by inoculating them with hernial material. Tubercle bacilli in histologic sections were demonstrated by Tscherning and by Broca.

Symptoms. Aside from the usual subjective and objective symptoms of a hernia, tuberculous hernia is characterized by a symptom complex which occasionally suggests its tuberculous character. In the majority of cases there are four cardinal symptoms present: (a) pain; (b) physical changes in the hernia; (c) irreducibility; (d) fluid in the sac. While pain is mostly always present, there is nothing characteristic about this symptom, for it may be slight or severe, continuous or intermittent; it may be local or irradiate toward the abdomen, or as in the case of Broca be entirely abdominal. The physical changes in the hernial mass are perhaps more pathognomonic. The sac and contents usually increase in size. Palpation reveals firm, irregular nodules, which have been mistaken for an adherent epiplocele and even for a hydrocele of the cord. Most of the tuberculous hernias are irreducible. There is mostly always fluids in the sac, particularly in the cases where a tuberculous peritonitis is present. In addition to the above symptoms the patients have the usual symptoms of tuberculosis, especially if there is demonstrable lesion of other organs.

Patel and Cotte describe three clinical types: (a) the latent form; (b) peritoneohernial tuberculosis; (c) herniotesticular tuberculosis, including the congenital tuberculous hydrocele. The latent form is the one which gives no specific symptoms and is usually discovered accidentally by the surgeon or in the postmortem room. The peritoneohernial tuberculosis manifests itself by symptoms of tuberculous peritonitis in addition to which there is fluid in the sac. The sac is irregular, nodular, and is partially or totally irreducible. The herniotesticular tuberculosis may be either a local tuberculosis or associated with tuberculosis of the peritoneum. The epididymis becomes tuberculous from the infection traveling along the patent processus vaginalis. The congenital tuberculous hydrocele is a condition described by Phocas in 1891 and also by Jartel in a thesis in 1901. The process may be purely local or associated with tuberculosis of the peritoneum. Phocas considers it a primary tuberculous lesion, while most of the pathologists as secondary to peritoneal tuberculosis. It is very difficult to differentiate it from a non-tuberculous hydrocele. It is quite possible that a large percentage of congenital hydroceles are tuberculous, the effusion being symptomatic.

HISTORY OF OUR CASE

A. M., 21 years of age, single, peddler by occupation, Greek. Was admitted to the Presbyterian Hospital on the service of Dr. D. D. Lewis, the 21st of April, 1910. He stated that two weeks prior to his entrance in the hospital he felt a sudden pain in the groin while walking very fast. Two days

later he noticed a mass the size of a hen's egg in the left groin, which increased in size while coughing and disappeared when recumbent. On examination we found that the patient had a left-sided inguinal hernia.

The hernial mass was very soft, somewhat painful to pressure and perfectly reducible. A general physical examination was negative, except for some distension of the abdomen. There was no demonstrable tuberculous lesion anywhere. The urine was negative. Leukocyte count: 6,900; hæmoglobin: 95 per cent. The patient was operated on April 22d by Dr. D. D. Lewis. After dividing the structures down the sac, the condition looked at first glance like a hydrocele of the cord. Subsequently, however, the sac was isolated from a normal cord. Upon incising the sac several ounces of clear yellowish fluid ran out. Pressure upon the abdomen renewed the flow, a large amount of fluid running out through the incised sac. The latter was studded with 10 or 12 small tubercles. In the presence of these findings, a diagnosis of tuberculous hernia was made and was interpreted as being a part of a more extensive process of the peritoneum. Two ounces of a 2 per cent formaline in glycerine was injected into the peritoneal cavity. The sac was transfixed and ligated. The repair was made without transplantation of the cord. As far as could be ascertained, the sac alone was tuberculous, the omentum contained in the sac being normal. The cord was normal. There were no adhesions of the sac to the surrounding structures. The patient made an uneventful recovery, the wound healing by primary union. Microscopic examination of the sac showed the typical histologic features of tuberculosis. Three months later the patient returned to the hospital with a right-sided pleurisy with effusion, which subsided in a couple of weeks. The inguinal region showed a linear scar.

Diagnosis. The condition was seldom diagnosed clinically. In a few cases the tuberculous process was not recognized even during the operation, the diagnosis being established by the microscope. The following clinical picture is suggestive of tuberculous hernia: Rapid increase in the size of a recent or an old hernia; associated tuberculosis of other organs, particularly abdominal; constitutional symptom complex characteristic of tuberculosis, although this may not always be present; pain with exacerbations, without any palpable reason for its occurrence, the so-called "crises douloureuses" of Jonnesco; partial or complete irreducibility; fluid in the sac, disappearing with recumbency and recurring when erect, this without gurgling sound, because if so, it may be due to the gurgling of fluid in a normal bowel. Thick, irregular, nodular sac; occasional symptoms of incarceration. The differential diagnosis must be made from a non-tuberculous hydrocele of the cord, from a properitoneal lipoma, from a simple peritonitis herniosa occurring in a non-tuberculous hernia; and from benign and malignant tumors. Malignancy is most common in umbilical hernias, the mass is hard, rapidly progressive, adherent to the sac and gives marked constitutional symptoms characteristic of malignancy.

Evolution and complications. Like other tuberculous processes, hernial tuberculosis may go on to healing by undergoing fibrosis. It may become complicated by tuberculosis of the lungs or of other organs. It may give symptoms of incarceration or actually become incarcerated.

Treatment. The operative procedure differs very little from that of radical cure for hernia. Almost any procedure can be employed except those of Macewen and Kocher in which the sac is not extirpated. As a majority of cases are associated with peritoneal tuberculosis, it is always a good plan to enlarge the incision upward so as to expose the peritoneal surface, thus inducing a hyperemia which, as we know, is often conducive to cure. A still more effective procedure is perhaps the one in which in addition to the incision a median laparotomy is made (Sordina, Carle, Villard). In the cases of François and Tricomi the recurrent symptoms necessitated a secondary laparotomy. In our case Dr. Lewis injected one ounce of a 2 per cent formaline in glycerine into the peritoneal cavity with the hope of producing a chemical hyperemia of the peritoneum and to promote leukocytosis. In animal experiments I have demonstrated that these two phenomena can be accomplished by the contact of formaline and glycerine upon endothelial surfaces. The operation offers great technical difficulties at times. Jordan and Roth were compelled to abandon the operation in a case where there was considerable agglutination of intestinal loops in the sac. In the case of Berger, the sac was so tightly adherent to the femoral vein that a piece of the sac had to be left in situ. In a few cases the sac was so adherent to the

testicle or epididymis that castration had to be resorted to. Broca castrated a patient because of too great adhesion to the vessels of the cord. If the loops of intestines are free and either normal or only slightly pathologic, after the exposure and incision of the sac, they may be returned to the peritoneal cavity. If they are considerably adherent and extensively pathologic they may have to be resected. Tuberculous omentum was resected in ten cases. Castration was practiced eight times. A simple radical cure was done in 80 of 121 cases. The operation was bilateral in six cases. In the cases of Tscherning and Lewisohn the operation on one side cured the non-operated side. The herniotomy was supplemented by a median laparotomy in eight cases. Carle drained the peritoneal ascitis in one case. Of 115 cases operated upon, seven died in the first week after the operation. Broca lost two cases from postoperative bronchopneumonia; another one from an extensive phlegmon of the groin. The cases of Brissaud, Lanelongue (Bordeaux), Mitchell, died from generalized peritonitis. Primary union occurred in 98 of 115 cases. In eight cases fistulæ formed which were very obstinate to treatment. Healing took place in the cases of Jordan, Roth, Sacquepé and Mellies after one year. Eight patients died from tuberculosis of other organs within a year of the operation. The patients of J. Baron and of Broca died one year after the operation from tuberculous peritonitis. Generally speaking, the prognosis of hernial tuberculosis is slightly better than that of peritoneal tuberculosis, but in a large measure it has many similarities. I wish to express my appreciation to Dr. D. D. Lewis for giving me the opportunity to study and to report this case.

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SUPPURATION IN THE RETROPERITONEAL SPACE

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A REVIEW of literature leads to the belief that infection and suppuration of the retroperitoneal glands from causes other than tuberculosis is somewhat rare. A few moments of study of this important subject may be of interest, and value also, in emphasizing the necessity for careful study of certain vague symptoms leading to the suspicion of deep seated disease located within the pelvis or abdomen.

Particularly does this apply to the analysis of infection complicating the puerperium. The retroperitoneal space is that ill-defined region that lies immediately outside of and behind the peritoneal cavity. It is made up everywhere of loose connective tissue, rich in lymph channels, and contains an abundant blood supply. Its intimate relationship to the abdominal cavity gives it an important place, and one not to be overlooked in dealing with many vague symptoms which occasionally accompany infection involving the appendix, mesentery, or pelvic organs in women.

The lymph nodes of the retroperitoneal space form two important groups, the mesenteric and lumbar groups, the latter including also the iliac glands. The former lie in the mesentery of the intestines and are closely associated with the mesenteric vessels. The latter lie to the sides of the vertebral column anteriorly, and extend from the superior mesenteric artery down to and below the bifurcation of the aorta. They have some slight connection with the alimentary tract through the lymphatics to the stomach and rectum, but their important connection is from the lymph channels from the pelvis and lower extremities. There is also connection with the lymphatics in the thoracic cavity. The lymphatics of the uterine walls are numerous and easily demonstrated. The collecting trunks extend laterally in the broad ligaments on each side of three different groups of glands. Those from the summit follow the Fallopian tubes out to the ovary, where they join the ovarian network, and accompany the collecting trunks of the ovary to the lumbar glands, around the termination of the ovarian veins. Those from the body of the organ extend across the broad ligament, curve around the Fallopian tubes, and enter the iliac glands, while those from the cervical region extend with those from the vaginal glands to the deep inguinal or hypogastric plexus.

There is, therefore, a complete network of lymph spaces and vessels which extends from the very lowest part of the pelvic cavity to the diaphragm, and even beyond.

This brief anatomical review serves to show how easily infection may spread along lines which under certain conditions offer little resistance. Also how a secondary infection may be flagged in the iliac glands in one instance and in the lumbar in another, or it may continue to spread from chain to chain until finally there is invasion of the thoracic cavity.

Tuberculosis, typhoid fever, appendicitis, suppuration of inguinal glands, and infection following labor and abortion, are the most common causes. Tuberculosis of the retroperitoneal glands, especially in children, is not infrequent and may be primary or secondary.

Primary tuberculosis of the mesenteric glands is rather common in childhood. Woodhead reports fourteen cases of tuberculosis of these glands in 127 cases of tuberculosis in children. Morph reports the presence of tuberculosis of these glands in 4 per cent of 232 autopsies. It may result from direct extension, from adjacent tissues, or from infection through the blood stream or lymphatics. The disease spreads, involving node after node until the whole cavity becomes filled with masses associated with adhesions. If suppuration occurs the pus may burrow extensively in the loose cellular tissue of the retroperitoneal space pointing to the loin above Poupart's ligament, or even extend into the thigh.

The symptoms may suggest Pott's disease,

appendicitis, perinephritic abscess, osteomyelitis, hip-joint disease, or it may be confused with various intra-abdominal conditions. A number of cases have been reported where acute tuberculosis of these glands has been mistaken for appendicitis. Appendicitis may be followed by infection of the retroperitoneal glands, and such infection may be a cause for persisting fever after an operation for acute appendicitis. Infection of these glands may occur after the original wound has closed, and give rise to a complication which if unrecognized may lead to a serious or even fatal result. Such a condition was seen by the writer in consultation. The diagnosis in this instance remained in doubt, further operative interference being refused, until proven at autopsy, when infection of the lumbar and mesenteric glands, with abscess formation, was disclosed.

Abrille in 1854 reported eight cases of retroperitoneal abscess. At that time few of the pathologists had given it serious attention. He divided infection of the retroperitoneal space according to its frequency into: (1) Abscess of the iliac fossa. (2) Abscess behind the peritoneum in the pelvic cavity. (3) Perinephritic abscess. He had no knowledge of the etiology, and divided it into traumatic and idiopathic.

W. G. Spencer reports a case, which from the history would seem to be a tuberculous infection. Neuman reports a similar case. Heilung reports a case which was probably a retroperitoneal abscess from an appendix located behind the cecum. Parker, a similar case. Osler reports a case where suppuration of the glands occurred in typhoid fever, and states that a number of such cases have come under his observation. Michie reports a case of this character which recovered after operation. Lehman and Frankel report cases where there was suppuration of the mesenteric glands with abscess formation. In both instances pus showed pure culture of the typhoid bacillus. Haman reports three cases, in one of which no apparent cause could be assigned. The first patient, age two years, gave a history of suppuration of the inguinal glands; the second, a vague history of the trauma; and in the third the history revealed no previous condition which might give rise to the infection. The symptoms of the three cases are summarized as follows: After a short period of pain in or about the groin and lower abdomen, there followed chills, fever, flexion of the thigh, more or less abdominal distension, and in a few days, a tender mass in the right or left iliac region.

In 1860 Samples described a case which is worthy of mention. It illustrates the end result of a neglected case of this variety of infection. In this patient, after a long illness the abscess opened at the umbilicus. Valentine reports a similar case. Pelfrey reports a case secondary to tubal infection.

The following case which occurred in the practice of the writer, illustrates this unusual complication during the course of typhoid fever:

E. W., age 18. Family history negative. Previous history, always well with exception of the usual diseases of childhood. Present illness began three weeks previous to admission to hospital. The early course of the disease was that of an ordinary typhoid infection; Widal positive and the clinical signs characteristic. Five days before admission, patient began to complain of pain in the abdomen. Patient states that he has been compelled to lie on his back with limbs flexed, and that the pain has been excruciating. It is most marked in the epigastric region, and the greatest point of tenderness is slightly to the right of the umbilicus. The abdominal walls are rigid, and there is a moderate distension. Peristalsis present. The picture is not one characteristic of general peritonitis. The pain is rather spasmodic in character, and at times is considerably lessened in severity. The leucocytes number 18,000. It was impossible to determine the exact course of the local condition, but a diagnosis of suppuration of the mesenteric glands was made. On account of the uncertainty of the diagnosis, and the presence of an increased leucocytosis, operation was advised.

Operation note. Incision through the right rectus. No adhesions to the parietal peritoneum; considerable fluid in the abdominal cavity. The omentum thickened and the seat of an inflammatory process. Several of the mesenteric glands were swollen to the size of a walnut. In attempting to remove them, rupture occurred and pus escaped. Further examination revealed the presence of a mass behind the peritoneum about the size of an orange. While carefully palpating the region referred to, rupture occurred and considerable pus escaped. There was active ulceration, but careful examination failed to show any evidence of intestinal perforation. The abscess cavity was drained, as were

also the suppurating glands in the mesentery. Patient died three days later from general peritonitis. Had it been possible to remove the suppurating glands completely, or to drain the retroperitoneal abscess without opening the peritoneal cavity, the result might have been different. The pus showed typhoid bacilli in pure culture.

Here was an undoubted case of infection of the mesenteric glands complicating typhoid and further complicated by a retroperitoneal abscess as a result of an extension of the infection from the glands in the mesentery to the lymph nodes behind the peritoneum with which they so freely communicate.

The so-called perinephritic abscess following puerperal infection has long been a matter of record, and it is surprising that involvement of the iliac and lumbar glands from the same source does not occur more frequently. Horsley reports three cases of perinephritic abscess following parturition. They represent this type of infection which finally locates in the lymphatics of the fatty capsule of the kidney, the bacteria having been carried from below. These cases illustrate so well this particular variety that an abstract is of value in further emphasizing the importance of this subject.

CASE 1. Mrs. G., age 32 years, admitted to the hospital October 27, 1904. Family history negative, and previous health good. About six weeks after delivery she began to complain of pain in the right hip, radiating down the thigh. It was severe, and interfered with walking. After this her back and right side became painful, and a tender mass was noted in the right flank. At the time of admission patient was much emaciated. The mass, easily palpated, was hard and immovable. It occupied the right flank, extending downward to region of the appendix. The right thigh and leg were flexed; temperature between 100° and 102°, pulse 120. Incision in the loin evacuated a quantity of pus.

CASE 2. Mrs. F., age 35 years, admitted June 20, 1905. Family history negative. Three months before admission, labor, which was followed by a mild degree of sepsis, had occurred. Pain in the right hip appeared a few days after delivery. There was fever, and loss of appetite; urine showed granular debris and a few pus cells, otherwise normal; temperature 100° to 102.5°. A fixed mass in the right flank could be easily palpated. Incision was made in the right lumbar region, and a quantity of pus evacuated.

CASE 3. Mrs. T., age 24 years, admitted March 17, 1906. Family history negative. Confined three months before admission. About four weeks after delivery, began to suffer from pains along the crest of the ileum on the right side. A few days later a swelling appeared in the right flank. Pain constant and severe in character, Patient had lost much in weight. Pulse 115 to 128; temperature 101°. On admission a large fluctuating tumor could be palpated on the right side above the crest of the ileum. More than a pint of pus was evacuated.

The writer is particularly impressed with the necessity for careful study in the analysis of puerperal infection. If the diagnosis is made early, and proper treatment instituted, the gravity which is caused by continued neglect may be greatly lessened or even prevented.

As a rule, it is easy to determine the presence of metritis, cellulitis, salpingitis, lymphangitis, phlebitis, or a peritoneal infection. Careful blood cultures made from a considerable quantity of blood will usually show bacteria in the blood stream, if present. All may be accompanied by lymphangitis or a phlebitis of the deep pelvic vessels, the presence of which may seriously complicate the infection, and in the end, if not recognized, be the immediate cause of death.

Trendelenburg found that in forty-three cases due to puerperal infection, there were eighteen of septicemia, twenty-one of pyemia, and four of combined lymphatic and venous infection.

It is quite probable that uterine lymphangitis is the beginning in most cases of general puerperal infection. That it remains local or becomes general depends upon the resistance of the patient. A glance at the lymphatic circulation of the uterus and adnexa, with its continuous channels upward along the iliac vessels to the lumbar region beyond, makes it seem remarkable that bacteria are not more often halted at some point, and as a result, destruction of cell tissue with abscess formation. Distension, which so often accompanies puerperal infection, is liable to interfere with early diagnosis. In the iliac variety there is pain early, with flexion of the thigh upon the abdomen. These symptoms, with elevation of temperature and chills, should lead to suspicion. If located higher in the lumbar region or about the kidney it is more difficult in the early stage, but later, when abscess formation has occurred, there should be little difficulty

in recognizing this condition by the local symptoms. The thing of greatest importance is to bear in mind the possibility of this form of puerperal infection.

Suppuration is somewhat difficult to diagnose, particularly in puerperal infection. The most careful attention should be directed to the history, the temperature chart, and the blood and urinary findings. The employment of this aid, together with careful examination, may often successfully interpret symptoms which are most obscure in character. The symptoms in suppuration of the iliac glands are fever, chills, pain in or about the groin, often extending into the hip, with flexion of the thigh. When located in the lumbar region, the pain is usually referred to this region, and there may also be a pain in the hip. This is also true in the abscess formation located about the kidney. In the early stage it is very difficult to make a diagnosis, but if we are on the alert it will always be considered in the study of any case of puerperal infection offering unusual symptoms. For example: when repeated chills and sweats with high temperature occur with no satisfactory explanation, either in the uterus or the adnexa or the cellular tissue surrounding them, when after repeated blood examinations no bacteria are discovered, we should consider the probability of this form of infection. It is liable to be confused with phlebitis of the deep pelvic or ovarian veins, as the symptoms are similar, and it would seem that these two conditions frequently coexist. So far as the treatment is concerned a mistake would not be serious.

The distinction between lymphangitis and thrombophlebitis is sometimes difficult, and it is quite probable that the two are combined in many instances. Lymphangitis occurs earlier in the puerperium than does phlebitis. There is also greater tenderness on pressure in the former. The latter may be accompanied by little or no pain. Chills and high temperature are common in both varieties. Repeated chills and high temperature with frequent remissions, are always diagnostic symptoms of considerable importance. In the opinion of the writer, thrombophlebitis of the iliac or ovarian regions may sometimes result in pus formation and give rise to suppurative conditions, similar to that caused by a spreading lymphangitis. Case No. 4, below reported, illustrates this variety and early operation in this patient doubtless prevented a more extensive involvement, as the inflammatory mass about the ovarian vein was removed before pus formation occurred.

The early observation revealing the large amount of inflammatory exudate about the vein suggests that infection traveling by this route may in some instances cause suppuration in the retroperitoneal space. It, therefore, becomes a factor in the etiology of this complication, especially when it occurs after labor or abortion.

Infection within the vein and of the lymphatic chain so closely associated with it, may occur at the same time, and yet be independent of each other.

In the so-called perinephritic variety pain on deep pressure is an early and continuous symptom. The pain in the hip is reflected through the lumbar plexus. Pain may be referred to the knee, thus simulating hip-joint disease. In the early stage there is considerable fixation of the spinal column, also stiffness in walking, and the body inclines toward the affected side. Pressure upon the deep veins sometimes causes swelling of the limbs. The treatment is early removal of the infected glands, or evacuation of the pus. This should be done by making an incision down to the peritoneum, pushing that membrane out of the way, thus removing the glands or evacuating the pus without entering the peritoneal cavity. This is easily done above Poupart's ligament, or higher if necessary, through the loin, by an incision large enough to work either way.

In dealing with phlebitis of the iliac and ovarian veins, this is also the better method for approaching this region, as it is possible to avoid opening into the general peritoneal cavity. If infection begins in the uterus and necessitates the removal of this organ together with the veins in the broad ligament, it then becomes necessary to do a transperitoneal operation. It is surprising how easily the vein and lymphatics in this region are

exposed by a long incision. Pushing forward and separating the peritoneum is not difficult and the danger of infecting the peritoneal cavity is greatly lessened. If there is doubt about the advisability of doing an extraperitoneal operation, it requires but a short time to open the abdomen in the median line and make a careful exploration. This gives a better idea of the extent of the disease and if it seems operable from behind the peritoneum, the abdomen can be closed and a second incision made.

The scant literature and the little attention given in the text-books to this form of infection following labor and abortion, justifies the report of four cases seen by the writer.

Mrs. S., age 32 years, multipara. Family history, negative. Previous health has not been good; resistance greatly lowered by the birth of several children in quick succession. The fourth labor occurred June 8, 1910. The membranes had ruptured forty-eight hours previous to the onset of labor; the delivery was otherwise normal. On the third day following there was a rise in temperature. This occurred on the fourth day and continued throughout the illness. All symptoms pointed to an infection, the nature of which seemed obscure. On the sixth day exploration of the uterus was done, and the cul-de-sac opened. Examination did not reveal sufficient trouble in the pelvic cavity to account for the clinical signs. There was slight thickening in the right broad ligament, but otherwise condition seemed normal. The uterus was normal and contained no foreign material. After operation the condition of the patient remained unchanged. Frequent chills, followed by high temperature and sweats, continued. Patient was seen by the writer fourteen days after beginning of the symptoms, and at this time patient presented the condition common to severe sepsis. The abdomen was very much distended; she complained of pain in the abdomen, which was most marked along the course of the right rectus below the region of the umbilicus, but not extending into the pelvic cavity. The distension was so great that it was not possible to palpate this region satisfactorily, and no swelling or enlargement could be detected in the deeper regions of the abdominal or pelvic cavities. The blood did not show the presence of any organism, and it did not seem to be an uncomplicated case of septicemia. Not until six days later did conditions permit the discovery of the mass in the abdomen. It was then easily palpated, and extended from the pelvic brim to a point 4 cm. above the umbilicus, and was located to the right of the vertebral column. The width of the swelling was doubtful, but was greatest about midway between the umbilicus and the pelvic brim. A diagnosis of infection, with suppuration, was then made.

Operation. Local and nitrous oxide anæsthesia. A liberal incision was made and above the crest of the ileum down to the peritoneum, which separated from the abdominal wall and pushed forward until the abscess cavity was reached. About twelve ounces of pus were evacuated. The serious condition of the patient prevented the expenditure of much time in exploration.

It was evident, however, that the pus cavity extended almost to the diaphragm, and that it was entirely retroperitoneal in character. Cultures of pus showed streptococci.

Patient rallied from the operation, and the outlook for recovery seemed promising. Temperature did not subside, as was expected, and the continued flow of pus, together with the continuance of elevation of temperature, rapid pulse, etc., justified the belief that we had failed to drain the whole of the suppurating cavity. The infection had undoubtedly traveled beyond the diaphragm. Pneumonia developed three days after operation, and death ensued forty hours later.

There was little doubt that involvement of the lymphatics above the diaphragm had occurred before the operation. The late diagnosis was unfortunate, but it was impossible to locate the trouble earlier. The experience gained from the study of this case emphasizes the necessity for the most painstaking care in the analysis of a case of puerperal infection.

Mrs. M., age 24 years, admitted to the hospital May 19, 1910. Family history, negative. Previous health always good. Menstrual history, began at fourteen; occurred every twenty-eight days; duration four days. No intermenstrual discharge, no dysmenorrhœa. Pregnancies: Had been pregnant once, labor difficult, instruments used. Present illness: It is difficult to elicit a satisfactory history of the early part of the puerperium. There was some elevation of temperature, which doubtless resulted from infection. About two weeks after birth of child patient had a chill, followed by pain in right leg. There was little swelling of the limb, but the pain and swelling prevented locomotion. The pain continued to grow more severe, extending into the pelvis and lower abdomen. After being in bed about two months an abscess appeared in the right groin, and pointed immediately above Poupart's ligament. Three months after birth of child patient was brought to hospital in a very emaciated condition.

Special note. May 20, 1910. Patient extremely emaciated. Thighs flexed on the abdomen, severe pain when slightest attempt at movement is made. The knee and hip-joints were so firmly fixed it seemed that bony ankylosis had occurred. It was impossible to secure the slightest range of movement. There is a sinus opening about the middle and immediately above Poupart's ligament on the

right side. The sinus extends upward behind the peritoneum, and opens into a cavity which extends from the fourth to the first vertebra. It does not extend into the pelvis, and does not in any way communicate with the pelvic organs. There is no evidence of necrosis of the bony structures. There are several bed sores on the back, the principal ones being over either trochanter and sacrum.

Pelvic examination. Lacerated perineum with relaxation of posterior vaginal walls. Lacerated cervix. Body of uterus slightly enlarged. Slight thickening, together with some restriction of movability of uterus behind, which is due to condition of the uterosacral ligaments. There is also some thickening in the right broad ligament. Pelvic organs otherwise normal. Blood culture shows staphylococci.

Operation. May 24, 1910. Under nitrous oxide anæsthesia opening above Poupart's ligament enlarged, allowing escape of considerable pus. Examination of the abscess cavity verified previous examination note. Abscess cavity drained with gauze. Patient recovered slowly, and was discharged November 4, 1910.

Mrs. G., admitted December 8, 1909. Family history, negative. Previous history, health has always been good. Menstrual history, began at the age of thirteen, has always been regular, periods of duration from three to four days. No pain, and flow normal in amount.

Pregnancies. First pregnancy occurred eighteen months previous to admission to hospital. Nothing unusual during pregnancy, and the delivery was a normal one. Two weeks ago an abortion occurred at about the second month.

Patient admitted to hospital December 8, 1909. She gave a history of fever, sweats, and chills, covering a period of ten days. Patient presents an appearance of extreme anemia, hemoglobin of 45. Lungs and heart normal. Liver and spleen negative. There is no tenderness over the abdomen. Patient complains of no pain in the pelvic organs. Pulse rapid, and general appearance of the patient is one commonly seen in the presence of profound sepsis.

Special note. Mucopurulent discharge from the vagina. Laceration of the perineum, cervix enlarged and retroverted. There is no thickening or infiltration in or about the adnexa. On the left side of the uterus there is a small mass extending from the uterus into the perimetrium. Its upper border is on the level with the superior border of the broad ligament, and its lower border on the level with the internal cervical opening. It is about 2 cm. in thickness, extends to the outer wall of the pelvis, and suggests the extension of the infection directly through the pelvis, via the lymphatics. There is very little tenderness, and careful examination reveals no evidence of any pus formation. The blood culture taken shows streptococcus in pure culture at the end of forty-eight hours. Diagnosis, puerperal bacteremia.

After six weeks' illness convalescence seemed established. On January 27, 1910, patient's temperature began to rise and she complained of considerable pain in the left lower quadrant of the abdomen, the point of greatest tenderness being immediately above Poupart's ligament, extending upward, and apparently located behind the peritoneum along the course of the deep vessels. This continued without any improvement. Bimanual examination showed no involvement of the tube or ovary on this side, but there was apparent thickness posteriorly, and a diagnosis of involvement of the retroperitoneal glands was made.

February 28, 1910. An incision was made parallel to and about 3 cm. above Poupart's ligament. The abdominal wall was divided, muscles and fascia in the direction of the fibers, down to the peritoneum which was pushed aside. Iliac glands were enlarged, extending upward along iliac vessels, a regular chain of elastic feeling glands. These were removed. They were necrotic, and contained pus which showed the presence of streptococci. The wound was partially closed with silkworm gut and drained. Since this time patient has made an uninterrupted recovery.

Discharged from the hospital March 25, 1910.

Mrs. V. B., age 26 years, admitted to St. Francis Hospital December 2, 1910. Family history, unimportant. Previous history, good health until present illness. Menstrual history, began at 14, always regular, no pain or intermenstrual discharge. Present illness began November 18th, after patient had been delivered by a midwife, labor normal, child living. Four days afterward patient had a chill, followed by elevation of temperature, also severe pain in lower abdomen. This condition existed until admission to hospital. There is marked pallor of the face, and the general appearance of anemia suggesting severe infection. Heart and lungs normal.

Blood count. December 2, 1910. W. B. C. 8,600, hemoglobin 80 per cent. Blood culture sterile at end of forty-eight hours.

Vaginal examination. No laceration of the vagina or cervix. Uterus subinvoluted, and of boggy consistency, mucopurulent discharge from the cervix. Patient complains of some tenderness in right broad ligament. Beginning at the outer portion of the right broad ligament, and on a level with the brim of the pelvis, there is an area of tenderness which extends upward in the line of the right rectus muscle to costal margin. The point of greatest tenderness is about 3 cm. below the level of the umbilicus. There is some distension of the abdomen. Slight rigidity along the course of the right rectus muscle, abdominal muscles otherwise normal. No palpable enlargements. Smears and cultures from the uterine discharge show staphylococci and Gram negative bacilli.

December 10, 1910. Patient's condition since admission unchanged. During this time there has been frequent chills, temperature ranging between

98 and 104 degrees. Patient continues to complain of some pain along the course of the right rectus muscle. On deep pressure the tenderness is very marked. No rigidity of the abdominal muscles. W. B. C. 6,800. Differential leucocyte count: Polymorp. neutrophiles 87 per cent, lymphocytes 8 per cent, large mononuclears and transitionals 5 per cent. Blood culture, negative. Vaginal examination reveals no change in pelvic organs.

Operation. December 10, 1910. Under ether anæsthesia a median line incision was made for exploratory purposes. Tubes, ovaries, and appendix were normal. There was a mass beginning at the outer end of the broad ligament and extending upward toward the kidney along the line of the ovarian vein and ureter on the right side. The mass being located behind the peritoneum and accessible from behind, the abdominal incision was closed. An oblique incision was then made just inside of the anterior superior iliac spine, about twelve cm. in length. The peritoneum was then stripped and an extraperitoneal exposure down to the mass was made. The mass was found to be composed of inflammatory exudate and softened lymph glands surrounding a thrombosed ovarian vein. The vein was ligated proximally and distally. All of the mass could not be removed. No pus was found. Gauze drainage was inserted, and incision partially closed. Following operation patient reacted well.

Forty-eight hours after operation patient's temperature, which had been ranging from normal to 101°, suddenly rose to 104 degrees, pulse 120, respirations 40. Patient was taken to operating room, the incision partially opened, and the drains changed. The indurated tissue seemed to be softening and breaking down. Some of this was removed.

Pathological report. December 13, 1910. Sections of the tissue removed at operation show thrombosed vein with organization of the thrombus, and an acute inflammatory exudate in the tissue surrounding the vein.

December 16, 1910. There appeared signs of pneumonia at base of left lung, together with pleurisy with effusion and an acute pericarditis. Temperature steady, 103 to 104 degrees. Three days later (Dec. 19) the left chest was aspirated and 400 cc. of bloody fluid withdrawn. Smears from the fluid showed streptococci. After three days (Dec. 22) the signs of fluid in left chest persisting, it was again aspirated and a like amount of fluid similar to above removed. The pericardicl friction rub has disappeared.

December 30, 1910. Wounds closed. Temperature, pulse, and respiration normal. Patient convalescent.

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DEPARTMENT OF TECHNIQUE

THE SURGICAL TREATMENT OF UNDESCENDED TESTICLE

By CHARLES DAVISON, M. D., Chicago, Illinois
Professor of Surgery and Clinical Surgery, Medical Department, University of Illinois; Surgeon to Cook County Hospital and The University Hospital

SURGICAL literature would indicate that the usual treatment of the undescended testicle, whether simple or complicated with hernia, follows closely the operation for inguinal hernia.

The inguinal canal is dissected as for the Bassini operation. The testicle and cord are liberated from the canal and from any adhesions that may exist.

The testicle is placed as near to its normal position in the scrotum as the short cord will permit. To hold it in the desired position either the cord is sutured to the external inguinal ring or the testicle to the bottom of the scrotum.

Published end results show that in a part of the cases the testicle remains in the scrotum and develops into a normal organ.

In a larger part of the cases the testicle retracts to the external inguinal ring and atrophies, leaving a functionless, tender, and painful organ in an unprotected position (1).

In the operation in which the spermatic vessels are ligated and severed as recommended by Bevan (2) the testicle can be placed and retained in the scrotum. But the nerves and lymphatics that accompany the spermatic vessels are also divided.

The blood supply is diminished to the testicle that is already poorly developed.

After separate series of experimental operations on dogs, both Miffet (3) and Griffiths (4), as quoted by Oidorne and Simmons (5), conclude that obliteration of the spermatic vessels causes degenerative changes in the testicle.

Moscheowitz (6) reports a series of experimental sections, in the current number of Annals of Surgery, of the spermatic vessels in dogs at the Pathological Laboratory of the College of Physicians and Surgeons of New York.

The testicles were later removed and examined microscopically. Some of them showed necrosis in the interior, the periphery presenting a fair state of preservation.

The experimenter concludes that his work has not shown convincing proof of perfect preservation of the testicular tissue after ligation of the spermatic vessels.

Whatever the congenital defect may be, in the undescended testicle, the mechanical cause of the retraction of the testicle is the shortness of the cord, from its makeup at the internal inguinal ring to the testicle.

If by transplantation of the spermatic vessels and the vas deferens, before they unite at the internal inguinal ring, if it were possible to make the spermatic cord sufficiently longer, so that the testicle could rest easily in the bottom of the scrotum, if these structures can be lowered by transplantation without material functional injury, then the end results should be successful.

If the vas deferens and spermatic vessels came together at the location of the external inguinal ring instead of the internal inguinal ring, the deformed cord would then be long enough to

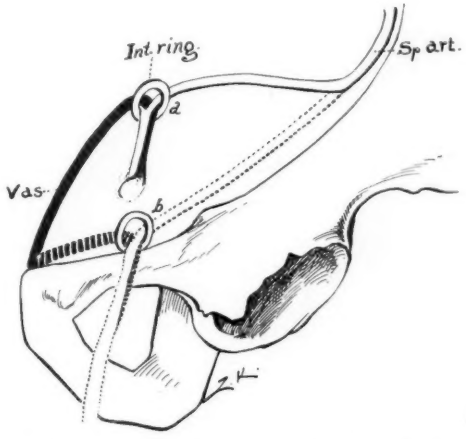

Fig. 1. Diagram showing method of lowering the spermatic cord by change of position of the spermatic vessels and vas deferens.

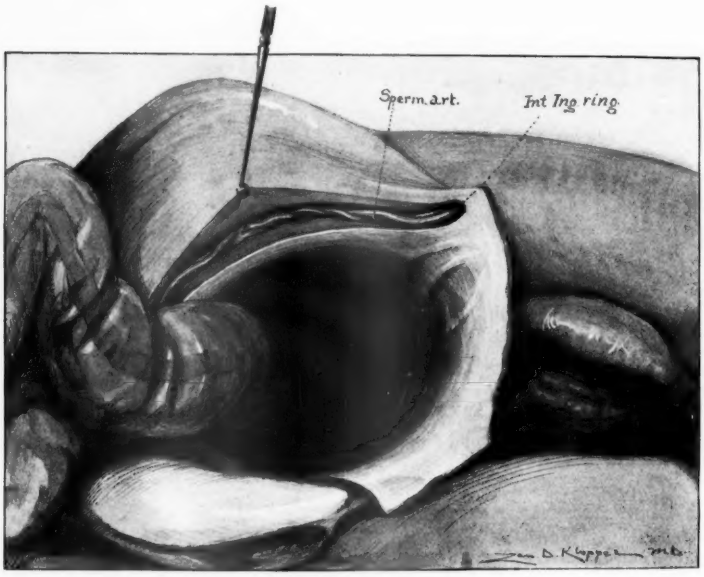

Fig. 2. Spermatic vessels above internal inguinal ring, showing double curve. (Anterior dissection — Front view.) Dissection by Dr. H. O. White, Professor of Anatomy, University of Illinois.

permit the testicle to rest in the scrotum in nearly all cases.

The proposed operation is to transplant the vas deferens and spermatic vessels so that their junction, to form the cord, is near the external ring instead of at the internal ring.

It is apparent that the vas deferens is amply long for this maneuver, because it drops down into the pelvis after passing through the internal inguinal ring, forming a loop only separated by the transversalis fascia.

The shortness of the spermatic vessels is the real cause of the difficulty in all operations for lowering the undescended testicle.

It seems almost certain that clearing the vas deferens by section of the vessels and cord coverings would disturb the vascular circulation, the lymph drainage, and the trophic nerve supply to such an extent as to interfere with functional secretion of the often imperfectly developed testicle.

Lengthening the cord by transplantation of its component parts saves intact the blood-vessels, the nerves, and the lymph channels.

The course of the spermatic vessels from the brim of the pelvis to the internal inguinal ring is poorly described in the text-books on anatomy.

Professor White has for me carefully dissected out the spermatic vessels in a number of cadavers, and the drawings by Dr. Klopper (Fig. 2 and Fig. 3) of the cadaver dissections, illustrate the course of the vessels just above the internal inguinal ring.

As the spermatic artery with its satellite veins nears the pelvic brim, it curves forward, inward, and then upward to the internal ring, lying just external to the peritoneum.

This direction uses length of vessels that can be utilized to lower the spermatic cord by transplantation of these vessels into a more direct route.

The peritoneum curved backward and inward, below the course of the spermatic vessels. The distance from the location of the vessels at the brim of the pelvis to the region of the external ring, if the artery were to follow the most direct possible course, would be considerably shorter than the natural course between the same points.

Advantage is taken of these anatomical conditions to lower the entire cord and with it the undescended testicle.

The principle of the operation depends on the direction of the spermatic vessels immediately above the beginning of the spermatic cord at the

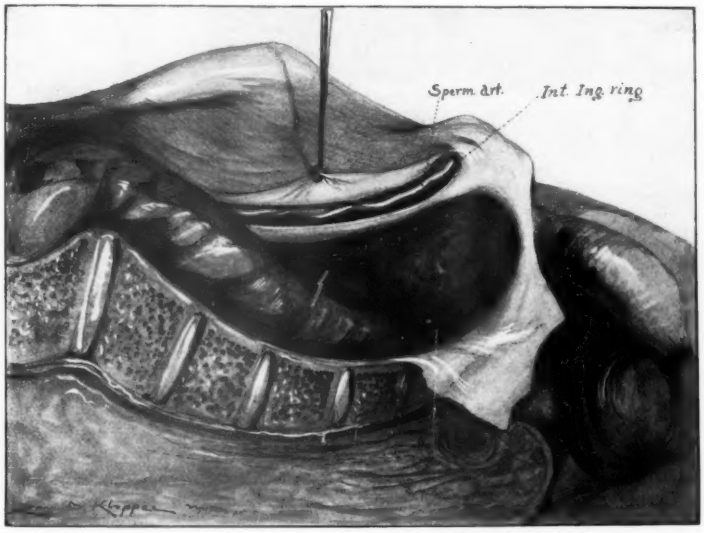

Fig. 3. Spermatic vessels above internal inguinal ring, showing double curve. (Vertical section — Lateral view.) Dissection by Dr. H. O. White, Professor of Anatomy, University of Illinois.

internal inguinal ring, and the possibility of lowering the whole cord by the transplantation of these vessels.

The operation consists of the following technique:

1. The inguinal canal is exposed by dissection as in the Bassini operation for inguinal hernia.

2. The testicle and cord are freed from the inguinal canal and ring and temporarily laid above the wound out of the field of operation.

3. The posterior wall of the inguinal canal is treated very similar to the Fowler operation for inguinal hernia.

After a preliminary double ligature of the deep epigastric artery, an incision is made through the posterior wall of the inguinal canal, from the internal inguinal ring to the pubic bone just beneath the site of the external ring (Fig. 4, transversalis fascia, cut from A to B). This destroys the internal inguinal ring and exposes the peritoneum with the vas deferens and spermatic vessels lying on it attached by loose cellular tissue (Fig. 5).

When congenital hernia is present or the processus vaginalis is patulous, the peritoneal layer is carefully separated from the cord and cut across. The distal part is allowed to cover the cord and testicle. The opening in the peritoneum is closed.

4. The reduplicated vas deferens is easily separated by gauze dissection from the peritoneum until the desired length is attained.

5. The external edge of the cut transversalis fascia is sharply retracted outward, exposing the spermatic vessels for some distance.

The spermatic vessels are carefully sponged loose from the peritoneum until they slip over the bulging peritoneum as a rubber band around an egg might slip from the middle toward the end.

Length of vessel is gained by following the long side of a triangle instead of both short sides (Fig. 6, b, a, instead of b, c, a).

Length of vessel is also gained by following the arc of a smaller circle. By separating the parts by gauze sponging, the lymphatics and trophic nerves of the testicle and cord are preserved.

The preservation of these structures with the natural blood supply gives the best prospect of the physiological and functional development of the testicle.

6. A bed for the testicle is made in the scrotum.

A silkworm gut suture is passed through the gubernaculum testis and both ends are passed through the most dependent part of the scrotum. The testicle is located in the scrotum.

7. The cut in the transversalis fascia (the posterior wall of the inguinal canal) is repaired. The cord is made to come through at the lower angle of the incision.

The internal inguinal ring is closed. The

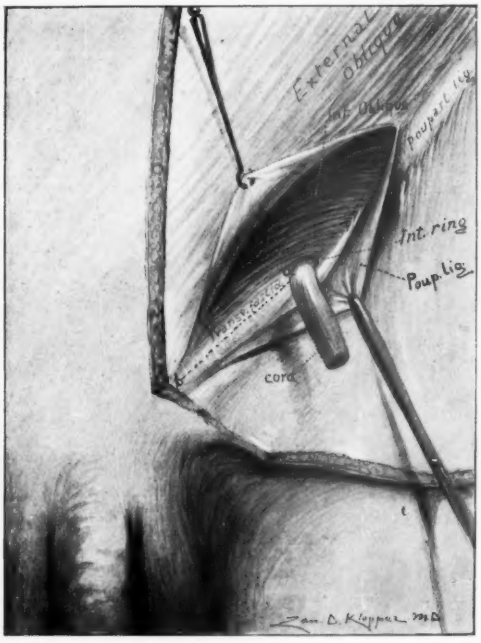

Fig. 4. Dissection of inguinal canal with cord displaced. Incision through posterior wall of inguinal canal (transversalis fascia) extending from internal ring to pubic bone. (Shown by dotted line a b.)

conjoined tendon is sutured to the under side of Poupart's ligament above the cord.

The fascia of the external oblique muscle is sutured to the edge of Poupart's ligament above the cord. The skin wound is closed.

8. A strip of adhesive plaster is placed around the thigh just above the knee, with a flap on the inner side of the thigh.

To this flap is fastened a thin rubber letter band.

The suture through the bottom of the scrotum is tied to the rubber band with only sufficient tension to make the band taut (Fig. 7).

9. The usual aseptic dressings are applied. A light plaster of Paris body cast or starch dressing is used to prevent flexion of the thigh and intermittent traction on the gubernaculum testis.

The operation should be performed by election at puberty. Before puberty the parts are small, delicate, and tender, and the operation is much more difficult.

Previous to puberty the normal testicle is immature. The seminal tubules are slightly developed. The interstitial tissue is abundant.

Fig. 5. Showing floor of inguinal canal split from the internal inguinal ring to the pubic bone, dividing the deep epigastric vessels and exposing the vas deferens and in silhouette the spermatic vessels lying on the peritoneum before they join to form the spermatic cord.

At puberty the seminal tubules increase in size, and the interstitial tissue decreases in relative quantity.

After puberty in the undescended testicle the conditions are reversed.

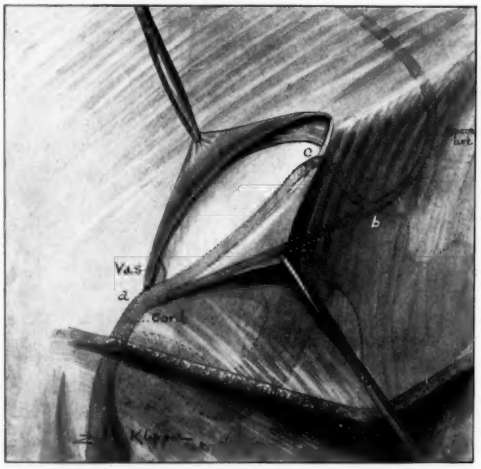

Fig. 6. Diagram of the transplantation of vas deferens and spermatic vessels — lowering the cord the difference between b a and b c a.

Fig. 7. Showing method of holding testicle in the scrotum by elastic attachment to the thigh.

Fig. 8. C. W. Age 16. Two years after transplantation of right testicle into scrotum.

The existing seminal tubules tend to atrophy and the interstitial tissue increases in relative quantity. If the operation is done at puberty nature is ready to do its part toward the development of such seminal tubules as may be viable.

There is a prospect that in at least a part of the cases the gland may develop into an organ of functional ability.

I wish to present three patients for you to examine as to their present condition. These cases were operated three years ago, two years ago, and three months ago, respectively, all of them showing the testicle in the scrotum.

These cases illustrate the operation on the adult, the youth, and the child.

CASE 1. C. W., 14 years of age, referred by Dr. Plice, operated upon three years ago. Diagnosis, right congenital inguinal hernia with undescended testicle.

Hernia of twelve or more years' duration

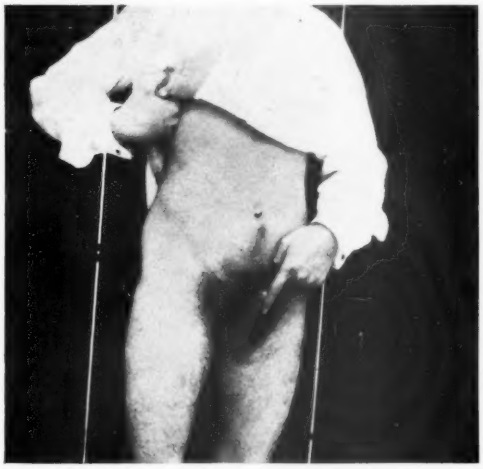

Fig. 9. S. Y. Age 20. One year after transplantation of right testicle into scrotum.

Fig. 10. H. P. Three months after transplantation of right testicle into scrotum.

Testicle had never been discovered. During the herniotomy the testicle was found high up in the inguinal canal. The gland was small and soft, the epididymis was irregularly strung out from the gland.

The cord testicle and epididymis was transplanted downward as described.

The photograph (Fig. 8) was taken one year ago, two years after operation, and shows the right testicle well in the scrotum.

CASE 2. S. Y., 19 years of age, referred by Dr. Yampolsky, operation two years ago.

Diagnosis, right congenital inguinal hernia with undescended testicle.

During the herniotomy the testicle was found in the inguinal canal just below the internal ring. The gland was soft, flabby and poorly developed, the epididymis was separate from the gland.

Downward transplantation was done as in the previous case.

The photograph (Fig. 9) was taken one year ago, one year after operation, and shows the testicle in the scrotum. The testicle is larger and more firm.

CASE 3. H. P., 6 years of age, referred by Dr. Tucker, operated three months ago. Diagnosis, right testicle undescended without hernia.

The left testicle was extremely small, but in the scrotum.

The right testicle was situated high up in the inguinal canal, about the size of a navy bean, and soft.

Operation transplantation downward.

Result, right testicle in the scrotum.

Photograph (Fig. 10) three months after operation.

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CASE OF COMPLETE AMENORRHŒA, WITH HEREDITY AS A PROBABLE ETIOLOGICAL FACTOR

BY A. R. HOOVER, M. D., AND J. K. MARDEN, M. D., MARSOVAN, TURKEY IN ASIA

THE patient is a Greek woman, coming from a town in Asia Minor near the Black Sea coast. Age about 40; general appearance that of a woman in good physical condition, average size and development of body, no evidence of defects of any kind, good average intelligence.

The patient came consulting us about some very minor complaints suggestive of that train of nervous troubles frequently accompanying the menopause. During the examination the fact was brought out that the woman had never menstruated in her life, that she had given birth to eleven children, five of whom were living at time of this examination. Further, that the grandmother of the patient had never menstruated in her life, that the mother of the patient had menstruated only once in every one to two years. Of the patient's children, one a girl of 14 years had not yet menstruated. The patient herself was married at 15 years of age, gave birth to her last child four years ago. Patient further said that she had never had symptoms of a menstrual molimen of any sort whatever, no knowledge of when her menstrual time might be due, no malaise, no pain, nothing in fact, saying that she simply lived like a man and didn't know what it was to be sick.

OPERATIVE TREATMENT OF DIFFICULT CASES OF PALATE DEFECT AFTER INFANCY [1]

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Clinical Professor of Surgery, Washington University Medical School, and Professor of Oral Surgery, Washington University Dental School

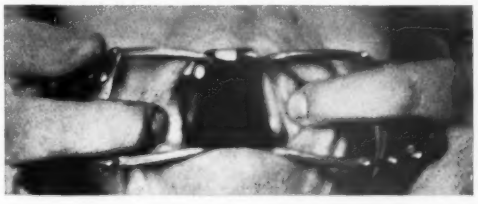
WITH very few exceptions, I believe that all cases of congenita cleft of the palate can be closed by what is commonly termed the von Langenbeck operation, but that in some instances certain accessory procedures are advisable and even necessary. In a few cases, usually those in which large parts of the soft tissue have been lost after previous unsuccessful operations, it may be necessary to employ radically different measures.

It is my purpose in the present communication to illustrate certain ways of utilizing this operation in difficult cases after infancy and also to present a plan of dealing with cases that, by most surgeons, have hitherto been regarded as practically inoperable.

The simplest modification of the von Langenbeck operation, and a very successful one, first proposed, I believe, by Julius Wolf, is applicable in cases in which the cleft is of more than moderate width compared to the available soft tissue of the palate and also in cases where these tissues are thin and atrophic. It consists of a two step operation. In the first stage the mucoperiosteal flaps are loosened from the bone through lateral incisions and the velum is detached from the posterior border of the palate process, but no incision is made at the cleft borders. The spaces between the flaps and the bone are packed with gauze for a few days, when the operation is completed in the usual manner. This procedure causes the tissues to stretch and to thicken and increases their blood supply. It is my custom to saturate the packing gauze with a 10 per cent solution of colloidal silver (Crede) and to stitch it in place. The silver solution seems to be non-irritating and is an efficient antiseptic.

Figure 1 is of a case of wide cleft in an adult before and after this step and shows the amount gained.

Figure 2, A, B, and C, are of casts made of this case before the first and after the final operation. The dotted lines show the exact location of the lateral incisions which, where practical, were carried to the outer side of the gums. This patient was forty-odd years of age and the operation was done because she was losing her teeth on account of a pyorrhœa alveolaris, and without a restoration of the palate she would not be able to wear artificial dentures. This case was one of the rare instances in which, though there



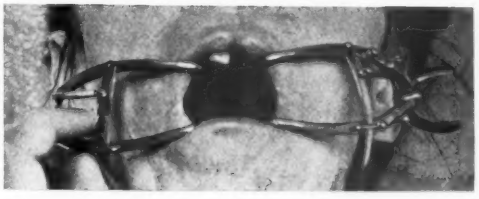


Fig. 1.

Fig. 2, A.

[1] Read before the Southern Surgical and Gynecological Association, Nashville, Tennessee, December 14, 1910.

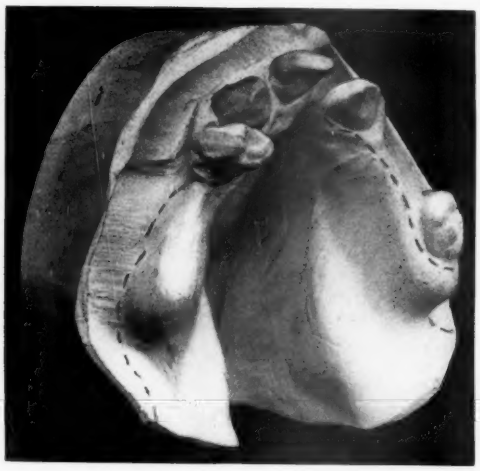


Fig. 2, B.

Fig. 2, C.

was a complete palate cleft, the patient had learned to enunciate almost perfectly by using the base of the tongue against the posterior wall of the pharynx to produce those sounds that ordinarily require the closure of the nasopharynx by the velum.

Figure 3, A and B, are of casts before and after the final closure of a wide cleft in an edenteous mouth by this method. Two previous attempts by the ordinary means had been almost complete failures. The case was that of a tuberculous adult, whose home surroundings were such that without teeth she could not get proper nourishment. All the teeth in both jaws had been removed before I first saw her. Figure B shows the final successful result.

Dr. G. V. I. Brown, of Milwaukee, and Prof. Herman Schroeder, of Berlin, have devised methods of narrowing the cleft in children by means of orthodontic apparatus. Brown recommends this in cases of eighteen months to two years as a substitute for the early Brophy operation, while Schroeder uses it up to nine or ten years.

Figure 4, A, B, and C, illustrate a case of a boy of six years with a cleft that was wide in proportion to the available palate tissue. Dr. LeGrand Cox, of St. Louis, constructed the apparatus for me from an expansion arch and in three weeks

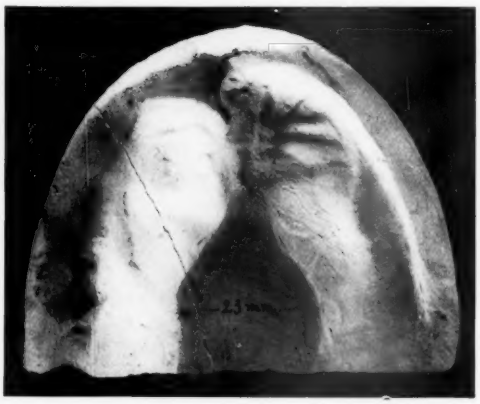


Fig. 3, A.

Fig. 3, B.

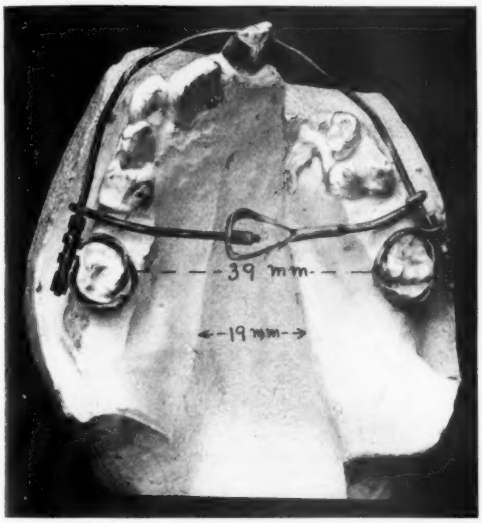


Fig. 4, A.

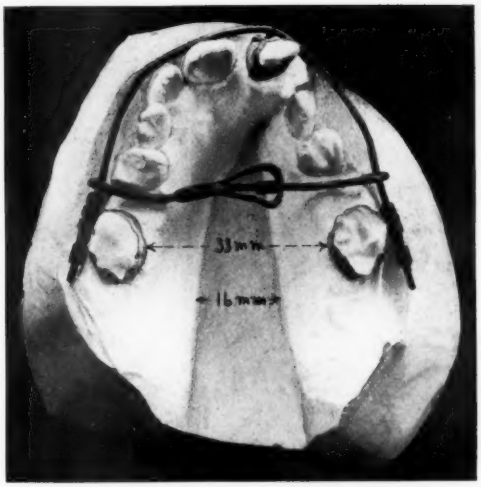


Fig. 4, B.

produced the result shown in Fig. 4, B. The amount gained at the posterior part of the palate cleft is shown in numerals, while it will be seen that the projecting intermaxillary process was pulled back into place and the alveolar part of the cleft approximated. Fig. 4, C, shows the final result, which was obtained without difficulty by the ordinary operation. After removing the clamps, the maxillæ later spring back to near their original positions.

I believe that either of the methods just described will be sufficient to care for any case of simple congenital cleft palate, but one can resort to Küster's method of lengthening the velum with much greater promise of success if some extra tissue is available (see Fig. 5, A and B), and there still remain those cases in which much or most of the soft tissues covering the palate processes have been lost from ulceration or from operations for the removal of growths or from sloughing after previous attempts to close a congenital cleft, and these can only be repaired by flaps derived from some extrapalatine source.

In a single cleft of the hard palate varying amounts of the mucoperichondrium and mucoperiosteum on the lateral surface of the nasal septum can be included in the broader flap (see Fig. 6, a). In single or double clefts a part of the mucoperiosteal lining of the nasal floor may also be included in the palate flap on the side contiguous to the cleft (see Fig. 6, b). In cases of congenital cleft, the loss of portions of the nasal mucous membrane does not seem to cause the disturbance that ordinarily results, at least the patients do not complain of any evil effects. If the posterior border of the velum has been preserved (and this is a part I have never observed to suffer from a postoperative sloughing) the velum and the posterior part of the hard palate can be reconstructed by the procedure illustrated in Fig. 7, A and B. The velum is to be detached from the palate process and the

Fig. 4, C

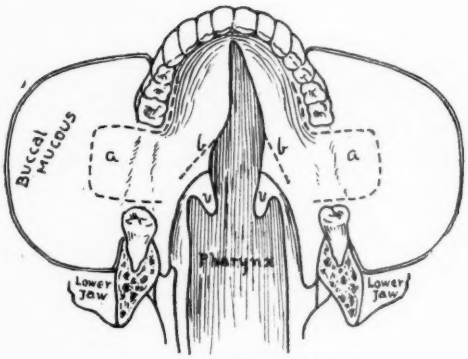


Fig. 5, A.

Figure 5, A and B. Küster proposed the plan by means of the incisions b–b of lengthening the velum, but there is rarely sufficient palate tissue to permit of this being done without leaving such wide gaps at the site of the lateral incision that subsequent scar contraction renders the velum too tense to move freely. The figure shows a modification which obviates the latter difficulty.

A, shows incision at lateral border of hard palate through the mucoperiosteum carried behind the maxillary tubercle and straight out on the buccal mucous for one and one-half cm., then backward to the level of the lower jaw, and then inward; again cutting the pterygomaxillary ligament. The mucous, pterygomaxillary ligament, and buccinator muscle are cut through and the flap is dissected up until the space between the internal pterygoid and tensor palati muscles is opened. The hamular process is cut across at its base.

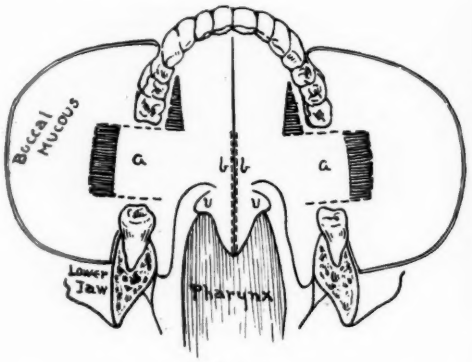


Fig. 5, B.

The cleft borders of the velum are not freshened in the usual way but the incisions b–b are made on each side through the whole thickness of the soft palate and the flaps behind these incisions are rotated backwards. In this way the incisions b–b are opened and the raw surfaces thus exposed are sutured to each other at the median line (see B, Fig. 5). As the two halves of the velum are carried towards the median line the flaps a–a are drawn inward and there will be no subsequent scar contraction to render the velum tense and comparatively useless. The space between the upper and lower jaw is still covered and opening of the mouth is but slightly interfered with. This operation gives a longer velum than is obtained by the simple von Langenbeck operation and therefore a better functional result. It will not permanently cripple the action of the superior constrictor muscle of the pharynx.

cheek incisions must be carried well out on to the buccal surface, otherwise the space just between the jaws will be bared of mucous membrane, and scar contraction would soon prevent the separation of the jaws.

The cleft in the hard palate may be restored by a flap turned from the buccal surface of the cheek or from the neck. If there is a harelip the border of the lip cleft makes a convenient base for the pedicle of the buccal flap. In a child a fairly extensive flap may be taken from the inner surface of the cheek without causing any inconvenience or deformity. This flap should include enough submucous tissue to insure the blood supply. If made from the neck the platysmamyoides muscle should be included.

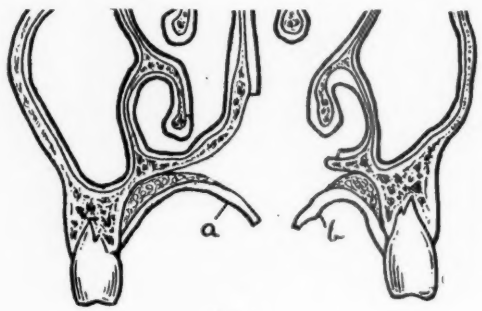


Fig. 6.

Figure 8, B, shows restoration in a young man after extensive postoperative sloughing.

Figure 8, A, shows condition after a second failure following attempts to close the cleft by the von Langenbeck operation.

In this case a flap two inches wide was dissected from the side of the neck and upper part of the chest with its base attached to the lower border of the cheek. It included skin, superficial fascia, and platysma muscle. It is necessary in planning such flaps to procure skin that will not grow hair. An incision was made in the bottom of the buccal alveolar cul-de-sac on that side and the flap was drawn into the mouth and stitched into the defect, the palate edges having been freshened. The defect in the neck was immediately repaired by undermining the superficial tissues of the neck and suturing. Ten days later the pedicle of the flap was cut and the

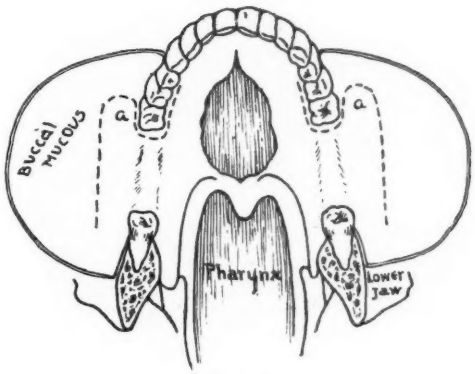


Fig. 7, A.

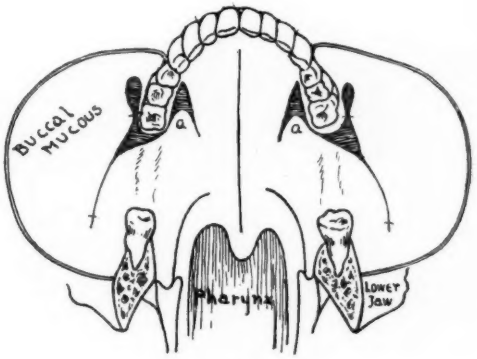


Fig. 7, B.

Figure 7, A and B. A, shows the incision that is made at the side of the hard palate through the mucoperiosteum and carried behind the maxillary tubercle and then skirts the alveolar process forward to the anterior border of the masseter muscle. It is then carried outward in the buccal mucous for one cm. and then backward. It cuts through the mucous membrane, and the buccinator muscle, which structures are raised in a flap as far inward as the tensor palati muscle. The hamular process of the pterygoid process is fractured at its base. As the palate tissues are moved towards the median line the flaps a–a are transferred to the palate and the defect in the cheek is partially effaced by two sutures. In taking up this cheek flap the anterior borders of the ramus of the jaw and of the internal pterygoid muscles are exposed and the space between the internal pterygoid and tensor palati muscles is opened by passing into a blunt instrument and pushing the velum towards the median line. B, shows the completed operation.

upper end of the neck defect repaired. Until the pedicle of the flap from the neck is cut the jaws must be held apart by some sort of an intraoral gag or splint. Such a contrivance is shown in Fig. 9, A, and was made for the case by Dr. Ruckstuhl of this city. The palate flap is also shown. The condition of the neck after removal of the flap is shown in Fig. 9, B. Owing to the abundance of tissue obtained this gives a longer velum and a better functional result than is ordinarily obtained in adults by the von Langenbeck operation. It leaves but a linear

Fig. 8, A.

Fig. 8, B.

Fig. 9, A.

Fig. 9, B.

scar to show where the tissue has been removed from the neck. In a number of cases where I have resorted to skin flaps from the neck, for the repair of mouth and palate defects, no inconvenience has been observed as the result of transplanting skin into the mouth. It soon takes on an appearance of closely resembling normal mucous membrane.

In one case I successfully resorted to this method in restoring part of the velum, the fauces of one side and part of the oral pharynx, after an excision for a malignant growth.

The idea of repairing palate and other intra-oral defects with epithelial tissue from other sources is not new; Blasius, Thiersch, Rotter, and other surgeons having reported such cases.

VERTEBRAL FRACTURE; INSERTION OF A WIRE "BACK-STAY"

By FREDERIC J. COTTON, M. D., Boston, Massachusetts

IN fractures of the spine attention has usually been directed to the complications resulting from lesions of the cord. There are however, many fractures of the spine in which there are no cord lesions, often not even nerve root lesions, and there are purely mechanical conditions to be considered.

Nearly all spinal fractures are fractures with kyphotic deformity more or less pronounced, and in a small proportion of cases we find a kyphosis that admits of no adjustment by compensatory curves, because there is a sheer lack of ligamentous tissue to hold up the weight of the body above the break.

I have seen but three such cases.

One was seen by me only as examiner in a medicolegal capacity, and my advice was not sought; had it been sought I should have advised operation. I do not know how this case progressed.

The second case was under consideration for operative relief when he began to show progress in the formation of supporting scar tissue; eventually his spine became firm, but with a kyphosis at the dorsolumbar region, compensated by flattening of the dorsal curve. He returned to his work as an iron foundry moulder within the year.

These were dorsal and dorsolumbar lesions.

The third case, a cervical lesion, is here presented:

John K., aged 32, laborer, slipped and fell on the sidewalk, striking his head. He was seen by a local doctor, who diagnosed a sprain of the muscles, and gave a prognosis of early recovery. He lay in bed for four days, then got up, but did not try to work for six weeks, and then found that lifting caused such pain in the neck that he quit.

Later he came to the Out-patient Department of the City Hospital to Dr. J. C. Hubbard, who recognized the condition and referred him to me.

This was on January 20, 1910. At this time he showed the peculiar attitude to be seen in Fig. 1. He could lift his head fairly well but could not hold it up. Physical examination showed nothing beyond the prominent vertebra seen in the illustration and a very well marked scar infiltration about the region of the seventh cervical spine. The X-ray findings are well shown in Fig. 2, a fracture of the sixth cervical vertebra (details not clearly visible even on the original plate) with forward displacement and with a greatly increased interval between the sixth and seventh spinous processes. Obviously such a separation as this plate shows could not exist save as a result of rupture of the ligamentum nuchæ, to say nothing of other lesions.

There were no signs of pressure on either cord or nerve roots, the problem was simply one of lack of support, a purely mechanical matter.

January 26, 1910, he was anæsthetized and an incision made down the lower part of the neck in the median line. The vertebral spines were exposed, and after they came clearly into view the wide gap between the sixth and seventh was clearly demonstrated. Wire sutures were passed about the fifth, sixth, and seventh spines and drawn taut with the head extended backward and made fast.

A number of sutures were inserted; the wire used was a very fine and very tough aluminum bronze, obtained from Rovsing of Copenhagen, and furnished me by courtesy of Dr. A. L. Chute. The total number of reinforcing

Fig. 1. Photograph before operation. This was the best position in which the head could be held long enough to take a picture. He could raise it somewhat higher for a few seconds. (Jan. 26, 1910.)

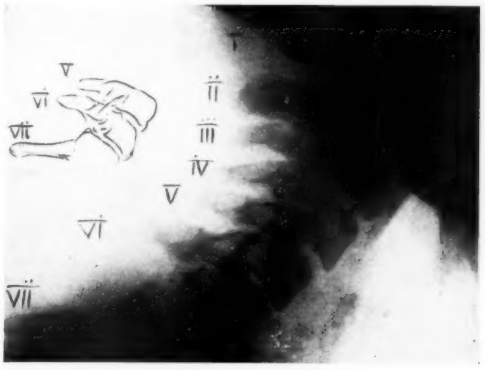


Fig. 2. Radiograph before operation. (Explanatory diagram in upper left corner.)

Fig. 3. After operation. There is a "cocoon" dressing over the wound. (Feb. 15, 1910.)

sutures was considerable, but owing to the small gauge of the wire, the bulk of foreign material left in was small.

February 8th, all stitches were removed.

February 16th. The "Thomas" collar worn for support was removed yesterday. He is able to hold his head up without trouble. Discharged to-day without supporting apparatus.

So far as I know this is the first case since the famous one of Hadra of Texas[1] in which deliberate reinforcement of the ligamentous strictures of the spine has been attempted.

It is a simple procedure, without risk, and in this case at least worked out very satisfactorily.

[1] Trans. Texas Med. Assn., Galveston, 1891, xxiii, 187.

I. A NEW BAG FOR THE HYDROSTATIC DILATATION OF THE CERVIX UTERI IN PREGNANT AND PARTURIENT WOMEN. II. A NEW HOOK FOR DECAPITATION

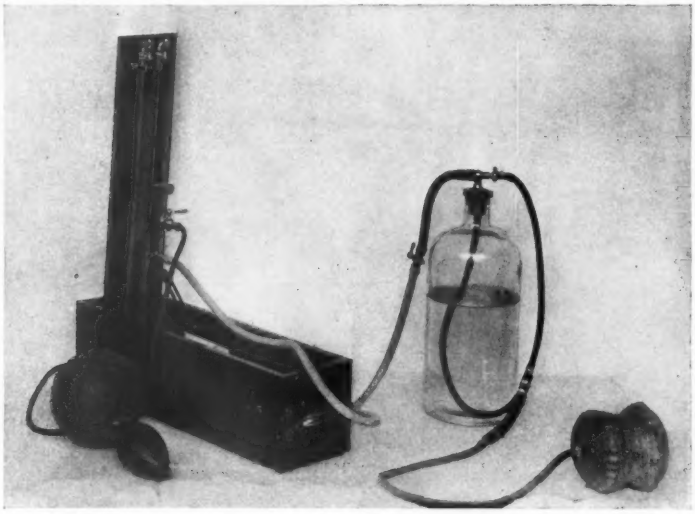
By BARTON COOKE HIRST, M. D., Philadelphia, Pennsylvania

IN common with most specialists who use them extensively I have been dissatisfied with the bags available for dilatation of the cervix. The Barnes' bag slips out of place, the Ribes' bag and its modification, the Voorhees', elongates the cervix and displaces the presenting part, the Pomeroy bag is too bulky and unnecessarily distends the vagina to a most painful degree. I have therefore had made two new bags in three different sizes, one a flattened hourglass, for the effaced cervix, the other a spool shaped for the uneffaced cervix; the first two inches, the second two and one-half inches deep, both having minimum transverse diameters of one, two, and three inches. My resident physician, Dr. Carson Coover, made an excellent suggestion in regard to the dilatation of these bags, namely, to attach them to the blood pressure apparatus so as to measure, decrease, increase, or maintain at one level the pressure exerted by them. I have used these bags in ten cases with satisfaction. They are, I think, a distinct improvement on their predecessors. A detailed account of their action in these and other cases will be published shortly by one of my students.

Bag for effaced cervix.

II

Any one who has referred to his clinic a number of impacted shoulder presentations with a dead fœtus, such as come into the Maternity of the University of Pennsylvania, must feel dissatisfied with the hooks for decapitation. The Braun hook, while easy to apply, occasionally fails to sever the neck; the Ramsbotham hook, while efficient in cutting through the neck, is difficult



Bag for uneffaced cervix attached to blood pressure apparatus and water bottle.

to apply on account of its long blade. I have had made, therefore, an angulated hook like the Braun's, with a slightly wider angle, and with a strong knife blade inserted in the angle, which is as easy to apply as the Braun hook and as efficient when applied as the Ramsbotham.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 9, 1910, WITH THE PRESIDENT, DR. JACOB FRANK, IN THE CHAIR

DOUBLE PULSATING EXOPHTHALMOS

REPORT OF A CASE

BY A. E. HALSTEAD, M. D.

Mr. A. G., aged 36, Pole, was struck on the head with a hard instrument, February 20, 1910. Two blows were struck and the second one rendered him unconscious. Both blows landed over the left temperomalar region. Patient was unconscious for a short time, then got up, and walked home, the blood streaming from his ears and nose. He was put to bed for the night and the next day was taken to the County Hospital. The facial paralysis was present when he awoke that morning and during that day he first noticed the roaring in his ears. He was in the hospital one month, and then home one month, and then was admitted to the Illinois Charitable Eye and Ear Infirmary. Here, because of panophthalmitis that had developed, the left eye was enucleated. Following this operation the orbital contents prolapsed onto the cheek, and were only held by passing sutures through the lids and retaining them in place until the exophthalmos had receded. At this time the right eye was in good condition and nothing could be found but a diminution in the range of vision, it being about 20:40. The left eye showed no vision, much exophthalmos, ulcerated cornea, edema, and a purulent discharge. While here he was sent to a neurologist for examination, and a diagnosis of a pulsating tumor at the base of the brain, probably aneurismal in character, was made. He was discharged from the infirmary September 28, 1910, condition improved, and vision in right eye normal.

October 5, 1910, he was again admitted to the infirmary to have the remnants of the conjunctiva removed, as he wished to get a glass eye. The stump was removed by Dr. Dodd, October 21, 1910. At this time the right eye was beginning to show signs of venous stasis, but was normal in every other respect. This condition continued to become gradually worse, and an exophthalmos began to develop, the conjunctiva to become more and more infiltrated, and the eye seemed to be in a fair shape to go as the other one had done. At first the fundus was persistently negative, but finally this, too, began to show signs of a venous stasis, and the vision again became 20:40. During this second stay in the infirmary an active antiluetic course of treatment was followed. November 8th, patient was transferred to St. Luke's Hospital on the service of Dr. Halstead.

The findings on admission were as given above for the right eye; also a complete facial paralysis on the left side. In addition to this he complained very much about the roaring in his ears and said that he heard it all through his head at all times. On auscultation over either malar region a very long loud systolic bruit could be heard. This was possibly a little more distinct on the left side and sounded like the churning of a waterfall.

November 10th he was operated upon at the St. Luke's Hospital. The carotid arteries on the left side of the neck were exposed by the usual method. It was found that the bruit could not be stopped except by compression of the common carotid artery. The common carotid artery was ligated and ligatures were also passed around its two divisions and the superior thyroid so as to have a control should the first ligature not be sufficient. The ligatures were all tied. The bruit disappeared immediately upon the tying of the ligatures, and has not returned to date, nor have any brain symptoms been noticed.

Patient's recovery has been uneventful, and within the last ten days he has developed a neuralgia which is confined principally to the second division of the right trifacial nerve. For

the relief of this the nerve division was injected with seventy-five per cent alcohol solution December 7th, which gave almost instant relief.

DISCUSSION

DR. WILLIAM FULLER: For pulsating exaphthalmos the greatest good appears to have come from ligating, in the majority of instances, the internal rather than the common carotid artery. Reasons for this are not difficult to understand. There is a great tendency to recurrence of the exophthalmos at times after ligating one or more of the large vessels of the neck; and following these recurrences, veins about the orbit have been ligated, and not without good results. In one case that recurred after ligating the common carotid, pressure maintained over the orbit at long intervals succeeded eventually in effecting a cure. It seems to me that this is worth more than passing notice; pressure sufficient to cause protrusion of the eyeball is not great and force sufficient to overcome this pressure, thus keeping the eye well within the socket, would appear to be a most useful after operative measure. Pressure over the orbit, continuously applied, following the ligation of the large blood-vessels in the neck, I believe would add much to the likelihood of a cure in the majority of cases.

DR. HALSTEAD (closing the discussion): The operations that have been done for pulsating exaphthalmos are ligation of the common carotid, the internal carotid, the external carotid on the same side as the aneurism. In one case Ransohoff reported to the American Surgical Association he ligated the superior thyroid with the internal and external carotids with the idea of preventing the return circulation through the superior thyroid. There are a number of cases, some sixteen on record, in which consecutive ligation of both common carotids was performed. There are also a number of cases reported in which both internal carotids have been ligated. Besides these operations on the vessels of the neck, we have the orbital operations. Of these we have the ligation of the ophthalmic artery, and ligation of the superior and inferior ophthalmic veins. These operations have proved curative in certain cases. If we take into consideration the fact that over seventy per cent of pulsating exophthalmos cases is due to arterovenous aneurism involving the cavernous sinus, it would seem rational, first of all, to ligate the internal carotid, on the side of the lesion. In these cases the operation of choice is ligation of the internal carotid or of the common carotid. The mortality from ligating the common carotid is a little higher than that from ligating the internal carotid; therefore, the latter should be ligated first if you ligate but one vessel. The reason I ligated all in this case was because of pulsation on the opposite side. In operating on the orbit we must realize that there are other conditions besides arterovenous aneurism which may cause pulsating exophthalmos. These may be a varicose condition of the exophthalmic vein; an arterovenous aneurism between the ophthalmic vein and ophthalmic artery; and aneurism of the ophthalmic artery alone.

With reference to the question asked by Dr. Fuller, I can see no reason for applying pressure to the eye after the operation is done, especially if we have an aneurism of the carotid artery to deal with. There are cases on record of bilateral pulsating exophthalmos due to aneurism on both sides. This condition is rare. The explanation that I offer for the pulsation in the eye on the opposite side to the injury is that the pulsation and increased venous pressure were transmitted through the transverse sinus to the opposite ophthalmic vein.

DR. CHARLES DAVISON read a paper entitled "Surgical Treatment of Undescended Testicle," which appears in this issue. (See p. 283.)

DISCUSSION

DR. DEAN D. LEWIS: I am very glad to have heard this paper, especially the description of the technique employed by the author. I recently operated upon a case, the patient was 34 years of age, both of whose testicles were in the inguinal canal. In this case the vessels upon the right side were very short, while the vas was long and tortuous. As soon as the vessels were divided the testicle could be brought down into the scrotum easily. It was not necessary to divide the vessels on the left side, for the testicle could easily be placed in the scrotum when some of the connective tissue bands were stretched. After purse string sutures had been placed to close off the opening into the scrotum, the testicles remained in position. As to the functional results following ligation of the anterior set of vessels, I can not say. But ligation of these vessels does not seem to have any effect upon the size or general appearance of the testicle.

DR. WHITE said the left cord is usually longer, the left vas is longer, and the right is shorter, and he asked whether, if the incision was made posteriorly or in the floor of the inguinal canal, it would not be better to incise the floor of the

inguinal canal say within one-quarter of an inch of the pubes on the left side and the pubic bone on the right side.

Dr. A. J. Ochsner: Since Dr. Bevan first demonstrated this operation I have many times operated upon these cases by the method he described, closing the hernia according to the method described by Dr. Ferguson and by Dr. Andrews, leaving the cord in the inguinal canal without bringing it out according to the Bassini method. This demonstration of Dr. Davison looks reasonable to me and it seems as though this operation is indicated in that class of cases in which the testicle is not curled up upon the cord, a condition which Dr. Bevan has described, and in which the operation simply consists in cutting the peritoneum and virtually unrolling the testicle, and thus securing a sufficient length of cord without ligating and cutting any important vessels. I believe in cases in which the operation cannot be performed by doing that, and at the same time bringing the testicle down into the scrotum so that it will lie there without suturing after the operation is completed, before the canal is closed, in the future I shall apply Dr. Davison's operation because it seems reasonable. It appeals to me as an improvement on the Bevan operation.

What the doctor has said as to the age of the patient I have observed for a number of years. The operation can be performed with much greater satisfaction after the child is about fourteen years old. In other cases in which there was a tendency to strangulation, or in which the patient suffered greatly, I have operated at a younger age, but the operation is not as satisfactory as when it is done later.

Regarding the method for holding the testicle down, I have found this method more satisfactory than any others I have tried. I have never tried the elastic ligature, however, but, in the first place, I make a large pouch in the scrotum which is very much like the one, I take it, that Dr. Davison has described. One most always counts upon a considerable amount of edema of the tissues of the scrotum, and one should insist upon making the pouch very large in performing this operation. I have placed the testicle in the scrotum and a number of little tension sutures of chromicized catgut at various points along the cord that is left, so that by picking up a small portion of the cord, without interfering with the remaining vessels, one is able to keep the cord down, and in that way there is nothing that will pull against testicle so the traction is all against the fine chromicized catgut sutures and not against the testicle, and the testicle of its own weight remains down in the scrotum. Then we fit the upper end of the sac carefully around the cord at some considerable distance above the testicle, in that way the testicle lies in its new bed without any disturbance whatever, and our results have been very satisfactory.

Dr. M. L. Harris: The secret of success in operations for undescended testicle is in getting sufficient length of the vessels. We find the vessels are long enough if they can be utilized. We must go up into the abdomen itself to get the vessels. The vessels that lie along the brim of the pelvis and approach the internal ring are not taut, but are more or less tortuous. If we go far enough up into the abdomen, raise up the peritoneum, and divide all the little connecting bands that hold the vessel in its tortuous course, so that it will open up, we will get sufficient length of vessel. I have never yet had to divide the vessels, and I have put the testicles down in the scrotum when they were entirely within the abdominal cavity.

Any case that will not permit the testicle to lie in the scrotum without tension when the canal is not sutured will not remain there after suture. It must lie there perfectly free of tension, and unless that is done I am sure the operation is not a success. I always maintain the gubernaculum where it lies because a great deal of the circulation comes through it. It nearly always extends down in the scrotum nearly the whole distance. I am careful not to cut it off, because quite a lot of circulation goes through it, and that helps the testicle. The testicle should be covered by the synovial sac, if possible. An Italian, whose name I cannot at present recall, made a number of experiments showing that if the tunica is removed from the testicle the spermatozoa are imperfectly formed, and that is the reason why we should preserve the sac, if we can, and we can practically always do so, at least I have found it so. I place the structures in the position Dr. Davison has described, entirely inside the muscles, and close the internal oblique and external oblique outside or anterior to the cord, bringing the cord out opposite the external ring, which is the shortest distance to the bottom of the scrotum.

As to the age at which we should operate, I think puberty is the best age. Examination of these testicles shows that between the ages of twenty and twenty-five years the testicle in these cases loses its power of making spermatozoa if it is retained in the abdomen. It is very doubtful if the operation is of any value so far as retaining the spermatozoic function is concerned

after twenty-five years of age. However, I do not wait until puberty to do the operation if the patient has a hernia, as so many of them have.

DR. DAVISON (closing the discussion): In answer to Dr. White's question, after the inguinal canal is opened and the transversalis fascia incised at all, it is an easy matter to finish the operation and carry down the cord to the point near the site of the external ring, as described in the paper. The testicle will retract if there is a particle of tension on the cord, if it does not lie slack in the scrotum.

It does not lose its contractility when the incision is ready to be sewed up. If you pull it down at that time it will retract. The testicle must be free from tension.

As to the Bevan operation, I look upon it as an advance over anything done up to the time that Dr. Bevan described his operation. There is no question but that anatomically the testicle is viable if the spermatic vessels are cut off. There is no question in my mind that in most cases the testicle would stay in position and live if the whole cord was cut off. In the Bevan operation, to cut the spermatic vessels, the sympathetic nerves that go to the testicle and the lympathics which drain the testicle must also be cut. The undescended testicle is a delicate organ, especially the glandular part, an operation that loses the trophic nerve action, the lymph drainage, and the main arterial supply cannot develop the function of the organ as well as an operation which retains the nerves, the lymph channels, and retains its main arterial supply. It seems to me opportune to mention in this connection the work of Moschowitz, who reports in the current issue of Annals of Surgery his operations on dogs, where microscopically there was molecular gangrene in the interior of the testicles, after experimental section of the spermatic vessels.

The operation I am proposing is very easily done. It is not harder than the technique of cutting off the vessels, as proposed by Dr. Bevan, and it seems to me in that class of cases where the condition of undescended testicle is double, where there is little prospect of procreation, every effort should be made to save or to promote the secretion of the semen, and if the nerve supply, lymph channels, and main blood-vessels are cut off it may not go on and develop into a functional organ and produce semen. The production of semen is a hard thing to prove because so many of these cases are unilateral like the cases I have shown. I cannot prove that these testicles are developing semen; if you follow patients for many years it is hard to prove that they develop semen.

As to the preservation of the sac of which Dr. Harris spoke I think you will find that is accounted for in my description. The processus vaginalis is dissected loose up near the internal ring, if there is hernia or a patulous processus vaginalis, it is placed around the cord to form the ordinary tunica vaginalis testis. The point of leaving the gubernaculum testis is a good one which I did not think of before. For convenience of operation, I separated and lifted the whole cord and testicle out of the canal out of the way to protect the testicle, knowing the testicle to be an organ at that time very much lowered in its vitality, but we have one more element of circulation by leaving the gubernaculum testis intact, and I shall endeavor to do so in the future.

DR. VICTOR L. SCHRAGER read a paper entitled "Hernial Tuberculosis," which is published in this issue. (See p. 270.)

DISCUSSION

DR. DEAN D. LEWIS: If I had been more acute, I would have made a diagnosis of tuberculosis of the peritoneum before I operated upon the hernia. Afterward I found that the lower abdomen was rigid, and this together with the leucocyte count should have aroused suspicion. I do not believe, however, that it would have been possible to demonstrate fluid.

DR. EMIL G. BECK: If tuberculosis of a hernia is secondary to tuberculosis of the peritoneum, then it seems rational that in every case where we meet a tuberculosis of a hernia we should look after the tuberculous peritonitis. We know that tuberculous peritonitis itself is secondary to tuberculosis in some other organ in the abdomen, and should find out which organ is affected. In women the Fallopian tube is usually the primary focus, in men the appendix or the intestine. It has been shown that tuberculous peritonitis is often cured by simply opening the abdomen, but in many of these cases the disease has recurred. In other words, after a year or so of improvement the peritonitis has sometimes recurred, and secondary operations have been performed, and finally the original cause of the disease was found, and when it was removed, a permanent and complete cure has taken place (Mayo). In cases of this kind which have been subsequently operated on for some other cause it was found that tuberculosis of the peritoneum had entirely disappeared. This fact is mighty interesting and a fertile field for investigation. If the disease, such as tuberculosis, exists in different parts of

the body, as for instance, when in the case of a tuberculous kidney, the bladder is also affected, the removal of the diseased kidney will cause a spontaneous cure of the bladder. The bladder recuperates or is cured without any surgical treatment after the kidney has been removed. Theoretically I should offer this explanation: With the development of the disease an immunity develops which attempts to keep pace with the progression of the disease. When we can increase the immunity by artificial means, such as sera and fresh air and rest, we can possibly overcome the disease, and then a cure takes place spontaneously as it does in many cases of tuberculosis of the lungs. When we can cut out a large percentage of the disease-bearing area, such as the kidney, there is such an amount of immunity left in the body which can take care of the remaining disease. I have undertaken some experiments on lower animals to prove this; it is too early to report. I think therein we may have the explanation for the cures of tuberculous peritonitis when the disease exists in neighboring organs. If we find a case of tuberculous hernia, then this represents only a little pouch of this tuberculous disease, and we should open the abdomen and try to find the focus which has caused the disease, and remove it.

DR. A. J. OCHSNER: I believe there is a lot in what Dr. Beck has just told us, because twenty-five years ago it was an accepted fact in many European clinics, for instance in the clinic of Professor Albert, in Vienna, if you saw a severe case of tuberculosis of the ankle or of the wrist, if amputation of the ankle was resorted to or of the wrist, the patient would get well of all his tuberculosis and get fat. In other words, if you amputate any one of the joints for tuberculosis a moderate tuberculosis of the lungs would disappear. I remember very well at that time that we would expect a patient whose case was complicated with pulmonary tuberculosis to die regularly if a resection was made, while if amputation was made the patient would recover from the tuberculosis of the lung, and of course the amputation wound would heal. But there is danger of the impression going out as the accepted fact that the form of treatment that Dr. Beck has mentioned in regard to tuberculous peritonitis is the proper treatment, namely, the removal of the diseased focus or portion. Now, as a matter of fact, I looked up the statistics on the treatment of tuberculous peritonitis six years ago, and found that the death rate in cases of tuberculous peritonitis had increased enormously by adopting that plan of operation. In other words, in cases in which simple drainage was made, the patient being supposed to be in a hopeless condition, a large proportion, seventy-five per cent at least, got well and remained so. There are many histories of cases in which a patient was operated for an ovarian cyst; tuberculous peritonitis was found, the abdomen was drained, and the patient left to die, but almost invariably this simple procedure was followed by recovery. Then another theory was advanced, and surgeons said it was wrong for us to subject these patients to such crude unsurgical measures, that we should remove the cause, and then they began to remove the cause and the mortality became very high. The same class of patients who almost invariably got well, if simply opened and drained, died if they were operated on thoroughly, so that later on, Fenger, of this city, brought together voluminous statistics and showed especially according to the European statistics that surgery was of very little use for tuberculous peritonitis because more relatively patients suffering from tuberculous peritonitis died following operation than those who had never been touched. But that was on the basis of doing a radical operation. If the Fallopian tubes alone are tuberculous, and if no other organs are involved, the removal of the tubes will result, especially where drainage is instituted, in a permanent cure in almost all cases; but if other portions are invaded, if you have accumulations of tuberculous material in the mesentery or the peritoneum, or adhesions of the intestine, for instance, then the mortality is enormously increased by removing anything.

I remember a case which I presented to this society some nineteen years ago. In this case I simply drained the peritoneal cavity. I could not distinguish between the uterus and ovaries and sigmoid flexure and cecum, as everything was one mass of tuberculosis, and still those tubes recovered from the tuberculosis and the patient became pregnant, bore two healthy children, and lived for many years afterwards. I have operated over one hundred cases of tuberculous peritonitis and am convinced that we must not give out the impression that removing organs for tuberculous peritonitis is good treatment.

DR. A. E. HALSTEAD: I have had one experience with a case of tuberculous hernia in a woman in which the hernial sac contained a tube. The tube was the seat of tuberculosis, and I opened the abdomen to see if the disease had extended into the general peritoneal cavity. It involved only the sac and adjacent portion of the peritoneum. I removed the tube, incised the sac,

and the patient recovered. She has been well now three years.

DR. CARL BECK: The paper of Dr. Schrager is very interesting to me. He spoke of tuberculosis in a hernial sac and of congenital hydrocele. It seems to me, in some of these cases the tuberculosis was primary in the hydrocele and not depending upon tuberculosis of the peritoneum. The tuberculosis has its origin in the epididymis rather than somewhere else in the abdominal cavity. I have had a chance recently to see a case of this kind of tuberculous hydrocele, and I have had the opportunity to make a laparotomy on the same patient, and found there was a total absence of tuberculosis in the abdomen, but there was tuberculosis in the hydrocele, so that I think that in this case the focus from which the tuberculosis began was the testicular tissue.

I coincide fully with what Dr. Ochsner has said, that in the last few years we have not removed such organs as the Fallopian tubes as we did formerly, but drained instead. In a case recently I have made a peculiar observation however. In a tuberculous peritonitis in a young girl I opened up and found a large sac smoothly covered with fibrinous masses containing millions of miliary tubercles, and the sac filled with clear fluid. In the bottom of sac I located two reddish openings, two rosettes. There was not a particle of anatomical structure in this cavity discernible except these two red buds. On further examination I found they were the two openings of the tubes. There is no doubt that in this case the tuberculous matter came out of the tubes. It would seem that in many instances the tubes are the original foci of contamination, and that in some cases where they are isolated, filled with tubercles, they should be removed. But where we find multiple tubercular foci, as in most instances, such as the retroperitoneal glands, and especially ulcerations of the intestine, as the cause of the tuberculosis, I think it would be unreasonable to remove one focus of tuberculosis and expect the general tuberculosis to heal out.

DR. WILLIAM M. HARSHA: I have not had much experience with hernial tuberculosis. I have seen one case to recognize it, and that was associated with general tuberculosis of the peritoneum. I agree with the last two speakers in respect to the propriety of removing organs which will increase the gravity of the operation. I do not think we can tell to a certainty in the majority of cases that the tuberculosis results from infection through the tubes, the appendix, or intestine. It is hard to tell. In the majority of cases I have seen, often in young women, I believe infection was due to intestinal blood or lymph sources. In some cases where the tubes have been involved they have been entirely agglutinated, so that they were no longer discharging, and I agree with the last two speakers that it is well for us to do as little as possible in these cases in the way of surgery.

DR. E. J. SENN: I have seen many cases of hernia in connection with tuberculous peritonitis. As is often the case, the hernia is caused by the tuberculous peritonitis. I have found the two frequently associated, and I think tuberculosis is a frequent cause of hernia.

DR. SCHRAGER (closing the discussion): Dr. Emil Beck has suggested that the proper thing to do is to go after the offending organ. It may, however, be difficult to identify the offending organ. We can divide the cases of tuberculosis in two large groups, those in which the mediastinal lymph nodes are infected from inhalation, and those in which the mesenteric lymph nodes are infected from the intestine. X-ray pictures taken of normal individuals show calcified tuberculous nodules in the mediastinum and calcified mesenteric lymph nodes.

I was interested in following a series of pictures taken by Dr. Potter for various conditions of the chest. Invariably I found shadows which indicated calcified mediastinal and mesenteric lymph nodes. This suggests that it is impossible to go after the offending organ. The fact that a certain organ appears to be tuberculous upon opening the peritoneum does not necessarily mean that this is the only organ which is tuberculous. The primary focus may be healed. Tuberculosis has a great tendency to heal, and an adhesion here and there, which is overlooked, may represent healed tuberculosis. Some patients have the primary focus removed and yet do not get well.

I know personally of a number of patients who have developed pulmonary tuberculosis after an anæsthetic. I recall a recent case. Dr. Beck knows of it. The man had a stone in the kidney which was removed. Everything was going along nicely, apparently, when he developed pulmonary tuberculosis, although he had no evidence of it before the operation. So, all in all, we cannot tell with certainty whether we remove the primary focus or not, nor can we claim that by removing the offending organ we can effect a cure. The fact that bladder tuberculosis is cured after the removal of the kidney is true only when the bladder is infected secondarily from the kidney. I think only in the cases of descending tuberculosis is the bladder influenced after nephrectomy.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF ORTHOPEDIC SURGERY

UNDER THE CHARGE OF

JOHN RIDLON, M. D.

JOHN L. PORTER, M. D. — A. STEINDLER, M. D.

E. W. RYERSON, M. D. — H. WINNETT ORR, M. D.

A Case of Scoliosis Relieved by Operation on One of the Transverse Processes. Z. B. ADAMS. *Am. Jour. Orthopedic Surgery*, November, 1910.

Adams reports a case of scoliosis accompanied by flexion and adduction of the thigh and marked limitation of movements at the hip and lumbar spine. Radiograms showed unusually long and broad transverse process on right side of 5th lumbar vertebra, which overlapped the iliac crest and had made a facet thereon. Through a vertical incision the enlarged transverse process was cut off and removed. Recovery uneventful. All symptoms were relieved but some scoliosis still persisted, two years after operation. JOHN L. PORTER.

Congenital Dislocation of the Shoulder. ABADIE AND PELISSIER. *Revue d'Orthop.*, No. 3, 1910.

CONCLUSIONS

1. Paralytic dislocation, due to intrauterine anterior poliomyelitis.

2. Obstetrical dislocation, either primary, caused by instrument in artificial delivery, or secondary, following obstetrical paralysis of brachial plexus.

3. Congenital, by primary maldevelopment of fœtus.

One case of congenital dislocation of the shoulder in a boy, 7 years old, is reported. Authors disadvise any operative interference, even osteotomy, since a functional adaptation of the muscles is to be expected anyway. A. STEINDLER.

Scoliosis Ischiadica in Flat Foot and Pes Valgus. T. PAL. *Wiener med. Woch.*, No. 25, 1910.

In cases of flat foot, sensory disturbances of the sciatic nerve often occur. Pal saw four cases in which a regular sciatic scoliosis developed on the basis of flat foot symptoms. These patients complained of pain in the hip and loin after standing on their feet for a long time and a lumbar scoliosis developed. Flat foot and pes valgus was found as the cause of these disturbances, which disappeared after the condition of the feet had been corrected. There were also paræsthesias of the outer side of the thigh. A. STEINDLER.

Bone Plasty After Resection of Long Pipe Bones. BITTNER. *Zentralblatt f. Chirurgie*, No. 16, 1910.

The entire lower third of the tibia was removed by Bittner for sarcoma. He then loosened from the tibia a splinter covered with periosteum and comprising almost one-half of the bone, twisting it upward 180° so as to bring the upper end down and fastening the latter with silk sutures to the remaining periosteum of the lower tibia and to the epiphyseal cartilage. The leg thus gained sufficient support. The torsion of the bone brought down the broader upper end of the bony splint, which could be fitted to the epiphyseal end to better advantage. A. STEINDLER.

Treatment of Structural Scoliosis. WALTER TRUSLOW. *American Journal Orthopedic Surgery*, November, 1910.

The author draws a sharp line as regards treatment and prognosis between simple functional scoliosis, which may be satisfactorily treated by gymnastics and hygiene, and the severe forms in which structural changes in the vertebræ have occurred with rotation and changes in the anteroposterior curves. He analyzes such a deformity into the following component parts:

1. Increase in anteroposterior curves.
2. Lateral deviations.
3. Rotation and accompanying distortions of the thorax.
4. Secondary distortions of the shoulder girdle.

He advocates attacking each part of the deformity separately by methods of forcible correction with plaster jackets, beginning with the last one to appear and working back through the clinical history to the primary distortion. The method of correction is chiefly through the position of the patient, while the casts are being put on, one position being used to influence the shape of the shoulder girdle and another for the anteroposterior curves.

The patient is suspended prone in a gaspipe frame supported by a muslin hammock and strips of bandage, with traction made forward and upward by a head sling. Then the jacket is put on in two or three sections, depending upon the degree

of rotation, and half-inch steel rods, two feet long, are incorporated transversely into these first segments to facilitate correction of the rotation.

After the plaster has set the rotary deformity is corrected as much as possible with the levers, at the same time pulling the segments apart so as to lengthen the spine. The levers are fixed to the gas-pipe frame to maintain the correction and the segments are fastened together by more plaster bandage covering the vacant spaces between them. Turns of plaster bandage are carried over the shoulders to help fix them in corrected position and may be left or later discarded after the jacket is hard. The levers are then cut off and the jacket trimmed enough to be comfortable and in two or three days, after the jacket is perfectly hard, windows are cut out over the hollow portions of the trunk to permit expansion. A length of bandage is placed under the shirting next the skin for a scratcher. The jackets are changed every four weeks, each time securing a little more correction.

Incidentally the author describes a very simple method for recording the spinal and scapular deviations. The article is well illustrated.

JOHN L. PORTER.

Treatment of Flat Foot Based Upon a New Principle. A. MOMBURG. *Deutsche Med. Wochenschrift*, No. 2, f. 1910.

If the os calcis is given a supination position Momburg found that the arch of the foot is being re-established. This can be shown by twisting the heel of a movable flat foot into supination, whereat the projection of the navicular bone disappears. If the metatarsal bones are then brought in horizontal position, this manipulation will effect a well shaped foot with a good longitudinal arch. According to these principles, a flat foot insole has been constructed by the author, which lays all the stress upon supination, while the actual raising of the arch is dispensed with. He deems it a great advantage that there is no pressure exerted upon the muscles, ligaments, nerves, or blood-vessels of the arch, the reassumption of function of the latter thus being unimpaired. The insole consists of a wedge shaped main part of rubber slanting from inward and pointed in front, under which a steel spring with leather sole is fastened with two rivets. A laced shoe with a broad, low four-fifth inch heel must be worn with this insole. A. STEINDLER.

Treatment of Congenital Hip Dislocation with the Bloodless Method. KIRMISSON. *Revue d' Orthop.*, No. 4, 1910.

The author in general follows Lorenz's technique. He leaves the first cast for three months, then in abduction and maximal inward rotation a second cast is applied encasing the entire extremity and is left in place for another three to five months. He does not operate before the third year and considers the seventh year as the upper limit. Kirmisson observed several fractures of the distal epiphysis of the femur, but never paralysis. He does not insist upon the patient walking about in the plaster of Paris bandage. Bilateral dislocations are being reduced in one sitting. He points out that both hips may be thoroughly different as regards the difficulties of reduction in spite of the X-ray findings being identical. Probably the anatomical differences in the capsules are responsible for that. These results are good in 68 per cent of bilateral and 87 per cent of unilateral dislocation. A. STEINDLER.

Coxitic Dislocations of Early Infancy. H. LIEGNER. *D. Zeitschr. f. Chir.*, b. cv., h. 3 and 4.

Among 128 cases of hip dislocation 11 cases with spontaneous dislocation following coxitis were observed. According to Liegner this dislocation of early infancy occurs in cases of metastatic osteomyelitic infection of the hip joint. The rapid and considerable extension of the capsule is responsible for the spontaneous dislocation. The X-ray findings are identical with the congenital dislocation, likewise the treatment. Even in cases of advanced destruction of the upper end of the femur the prognosis after reposition of the hip is favorable. The snapping sound of reposition and the primary stability as observed in congenital dislocations, however, are absent. Prophylactically the wide opening of the joint in suppurative coxitis of early infancy is of importance. A. STEINDLER.

Sciatica and Its Physeotherapy. T. V. BREEMAN. *Med. Tydschr. v. Geneeskunde*, July 9, 1910.

In chronic cases the treatment differs with the etiology. In rheumatism Breeman advocates massage especially kneeding (petrissage) and friction also heat. Cases with uratic diathesis are much benefited by shower baths and Fango. In neurasthenic patients general treatment is of importance. Sciatica due to colds or traumatism will improve on shower baths, Fango and superheated air. Sciatica may persist in diabetes even after the disappearing of sugar in the urine. In very chronic cases Breeman recommends mechanotherapy. Only when the physeotherapy fails entirely surgical treatment should be considered. A. STEINDLER.

Transplantation of Hip Joint and Upper Third of Femur from the Cadaver. KUETTNER. *Zentralbl. f. Chir.*, No. 17, 1910.

After resection of the hip joint and the upper third of the femur because of chondrosarcoma, an implantation of these bones was perfected, the bones being taken from a man 11 hours after he had died from tumor of the brain, the body being perfectly normal otherwise. The joint was kept in saline solution to which some chloroform had been added and 24 hours later the operation was performed. The wound healed without reaction and the X-ray showed a faultless position of the newly implanted joint. A. STEINDLER.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF SURGERY

UNDER THE CHARGE OF

FREDERIC A. BESLEY, M. D.

GEORGE E. BEILBY, M. D.
J. S. EISENSTAEDT, M. D.
FRED C. ZAPFFE, M. D.
ARTHUR B. EUSTACE, M. D.
WM. R. CUBBINS, M. D.
FREDERICK G. DYAS, M. D.
JAMES F. CHURCHILL, M. D.
JOHN A. WOLFER, M. D.
AIMÉ PAUL HEINECK, M. D.
G. T. COURTENAY, M. D.
B. J. O'NEILL, M. D.
H. A. POTTS, M. D.

Fibrinogen of the Blood as Influenced by the Liver Necrosis of Chloroform Poisoning. WHIPPLE AND HURWITZ. *The Journal of Experimental Medicine*, vol. xiii, No. 1, p. 136.

During the course of some experiments on chloroform poisoning in dogs, which the authors were pursuing, they noted that operations upon many of these animals resulted fatally because of uncontrollable hæmorrhage. At autopsy they frequently found that the abdominal cavity was full of fluid blood, and, in cases of extreme poisoning, even the blood-vessels and heart contained fluid blood and no blood clots. They undertook this series of experiments with the hope of clearing up this feature of chloroform poisoning, but, as the work progressed, it seemed to throw some light on interesting problems connected with blood coagulation and liver function. Briefly, these experiments were interpreted by the authors as indicating clearly that fibrinogen is formed by the liver or that its formation is quite dependent upon the functional activity of that organ. It was clearly shown that fibrinogen in the blood can be made to decrease or almost to vanish at will through the production of liver necrosis by chloroform anæsthesia. Also, the drop of fibrinogen is found to parallel closely the extent of liver necrosis, and, in severe poisoning where the liver shows extensive necrosis, the fibrinogen may be practically absent. In this later condition, which is not unlike hemophilia, the animal bleeds steadily from large or small cuts. Moreover, the fibrinogen reappears in the blood as the liver begins to repair the injury to its lobules and keeps pace with the repair of the liver cells. The repair is very rapid and may be complete in five or six days.

In a former study carried on by the same authors it was shown that the liver is quite capable of repairing the injury done to it by chloroform anæsthesia, even when the central necrosis of each lobule involves one-half to three-fifths of all the liver cells, the repair begins on the second or third day and is almost complete in six or seven days. The dead liver cells are removed by autolysis and phagocytosis, and the reticulum is filled in by elongation of the cords of liver cells effected by a rapid mitotic division. The end result is a normal liver. If this mechanism of liver necrosis and repair is kept in mind, it is easy to follow the fluctuation in the fibrinogen content of the blood, as the two are parallel.

The two other factors of blood clotting, thrombin and calcium, were followed in several of the severe cases of poisoning and were found normal. This, they state, is in harmony with observations on the character and formation of the blood clot in these cases. They found that blood drawn from animals poisoned by chloroform anæsthesia will clot in the usual time (four to seven minutes), but the clot is more or less flabby, depending upon the amount of fibrinogen present. In severe cases, the clot may be a filmy network which will shrink away from the walls of the cylinder and settle to the bottom, forming a very soft, purplish jelly-like mass of not more than five to ten per cent of the volume of blood. A glass rod can be passed through it with ease, and the threads of fibrin are very delicate and inconspicuous.

It is obvious that hæmorrhage, which may be a marked feature of these cases, is due to an inefficient blood clot and not to the absence of clotting. They found it almost impossible to render an animal's blood quite free from fibrinogen by chloroform poisoning, but easy to damage the liver and lower the fibrinogen content to such a degree that the animal will bleed for hours from pricks or cuts in any tissue. They observed, in general, that these animals do not show a tendency to hæmorrhage until the fibrinogen has been reduced ten per cent. The clot would form in the usual time but lacked body and stiffness. As the latter characteristic is dependent on the presence of fibrinogen, the clots are too weak and flabby to close the ruptured capillaries and vessels. Their experiments carried out on twelve or more dogs showed very uniform results and may be briefly summarized as follows:

Chloroform anæsthesia for two hours or more will cause more or less central liver necrosis in dogs, depending upon the length of the anæsthesia and the susceptibility of the animal.

If the fibrinogen of the blood of such an animal be estimated at intervals, it is found that this proteid shows a drop corresponding to the amount of liver necrosis.

By administering chloroform, the fibrinogen may be almost eliminated from the circulating blood, and the poisoned animal may bleed for hours from small skin pricks or cuts.

The liver can recover from a grave injury due to chloroform and return practically to a normal condition in about ten days.

The fibrinogen reappears in the blood as the liver effects its repair. It seems that the quantity of fibrinogen present is a good indicator of the liver efficiency and a fairly accurate index of the amount of liver injury.

In severe cases of chloroform poisoning, the calcium of the blood was normal or slightly increased, and the thrombin was normal.

The hæmorrhages of chloroform poisoning are due, not to lack of blood clotting but to inefficient coagulation. The clot has not the body and toughness supplied by the fibrinogen, and is, therefore unable to check even capillary hæmorrhage.

Fibrinogen is either formed in the liver or is wholly dependent upon liver activity for its production.

GEORGE E. BEILBY.

The Operative Treatment of Congenital Incontinentia Vesicæ. PROFESSOR RUDOLF GOEBELL. *Zeitschrift für Gynakol. Urologie*, bd. ii, No. 4, 1910.

In the case of a young girl with epispadias and complete incontinency, after an operation in which he brought about a closure of the separated sphincter vesicæ without amelioration of symptoms, Goebell recommends the following operation, the result of which, though not ideal, may be considered as exceptionally good.

Technique. About 2 cm. above the symphysis pubis the transverse Pfannenstiel incision was made through skin and aponeurosis. These were prepared upward by blunt dissection except in the linea alba where it was necessary to separate by use of scissors. Thus the musculæ pyramidales were exposed. These were cut loose from their insertion to the symphysis pubis and the recti separated laterally. The bladder, previously filled with boric solution, was freed from the loose tissue anterior to it, the peritoneal covering dissected upward and the neck of the bladder exposed. The neck of the bladder was then carefully dissected from the vagina and the two musc. pyramidales separated from each other, the free ends pulled down under the bladder neck and the sutures placed between it and the vagina, uniting the two muscles. Two silk sutures were placed above so that the pyramidales formed a ring completely surrounding the colus vesicæ. (If the muscles are long enough he strongly recommends their being *crossed* under the neck of the bladder.) A catheter of the Pezzer type was left in place and the incision closed, a small tampon and drain being left in the wound.

The after treatment consisted in irrigating the bladder three times a day and the administration of urotropin in half gram doses twice daily. At the end of the first week the catheter was removed. On the ninth and tenth day respectively the tampon and drain, and on the thirteenth day, the stitches. In less than six weeks the child was discharged. Subsequent history: The child remains dry during the day and when awakened once at night to urinate does not wet the bed.

J. S. EISENSTAEDT.

The Radium Treatment of a Prostatic Sarcoma (Radiumbehandlung eines Prostatsarksoms). R. POSCHKIS AND W. TITTINGER. *Wien. klin. Wchnschr.*, 1910, xxiii, 1715.

The sarcoma of the prostate occurred in a 32-year old man. Diagnosis confirmed pathologically. Radical operation was deemed inadvisable, so the bladder was drained.

Into the fistulous opening a tube containing 4.7 mgm. of radium was introduced and allowed to rest on the sarcoma. This was continued in place for 20 minutes. After 21 treatments at intervals of about two weeks the swelling had disappeared, and all signs of the tumor were missing. The writers do not regard the case as cured but simply record the temporary success of the treatment.

C. G. GRULEE.

The Operative Lowering of Intracranial Pressure in Tumors and Other Brain Diseases (Ueber die operative Druckentlastung des Gehirnes bei Tumeren und anderen Gehirnkrankheiten). G. ANTON. *Wien. klin. Wchnschr.*, 1910, xxiii, 1703.

The writer reports the results on 37 cases in which the intracranial pressure was reduced by puncture and drainage of the lateral ventricle. From this experience he draws the following conclusions:

1. The operation is indicated in hydrocephalus with thinning of the cerebral cortex, to prevent pressure on the cerebellum.

2. In cases of hydrocephalus from brain tumor, blindness can be prevented and headache, dizziness, and vomiting relieved.

3. The condition in the ventricle can be studied during the operation.

4. The operation may be used after the skull has been opened for relief of intracranial pressure, to reduce a brain hernia.

5. The operation may be used in the diseases of the optic nerve caused by tower skull and similar deformities.

C. G. GRULEE.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF OBSTETRICS

UNDER THE CHARGE OF

C. S. Bacon, M. D.
Heliodor Schiller, M. D.
Herbert Marion Stowe, M. D.
C. G. Grulee, M. D.

A Critique of Cervical Cæsarean Section (Zur Kritik des Cervicalen Kaiserschnittes). Richter, *Archiv für Gynäkologie*, bd. 91, h. 2.

The field of cervical Cæsarean section in the therapy of pelvic contraction embraces those cases where the classical operation is not indicated because of the suspicion or presence of septic infection and an aversion, always justifiable, exists to perforating the living child. If the technique of the cervical operation can be simplified so as to fall within the limits of the less experienced operator, a definite advance in obstetric surgery is inevitable.

Richter, in speaking from an experience of twelve cases of the cervical operation and fifty of the older method, is inclined to favor the latter technique. His twelve cases were operated upon by various methods including the Sellheim and Latzko recommendations. Two main indications are noted: (1) pelvic contraction with a true conjugate varying from 5 to 8 centimeters, and (2) in doubtful cases where it is uncertain whether hebosteotomy or the classical operation is indicated.

The author's technique is briefly as follows:

Pfannenstiel's incision, lateral retraction of the musculature down to the parietal peritoneum, examination for the plica, retraction of the filled or empty bladder toward the right until the lower uterine segment is exposed, longitudinal incision in the median line, introduction of one blade of a small Boerma forcep under the fœtal head and attempt at extraction and eventually the application of both blades and final delivery. The placenta is expressed or removed manually. The various layers are sutured separately and a small drain is inserted in the lower angle of the wound and removed in thirty-six hours. To insure against hæmorrhage, a hypodermic injection of ergotin is given before the operation is commenced. One mother was lost on the third day from peritonitis and her condition was unfavorable from the first. All the children were saved.

In commenting upon the difficulties of the operation, the author states that he encountered serious hæmorrhage from the cervical incision in five cases, moderate hæmorrhage in three, and slight bleeding in two others. This is not remarkable as the operation is performed after a tedious labor in a thinned lower uterine segment while the strength of the uterine contractions are greatly reduced exclusive of the effects of anæsthesia. In the classical Cæsarean section performed at the beginning of labor, the incision is made in thick actively contracting muscles and hæmorrhage is the exception.

Manual removal of the placenta was necessary in ten cases, as it was thought imprudent to await a more or less delayed spontaneous expulsion. The difficulty of extraction was enhanced by the size of the incision. After a tedious labor with the head pressed in the inlet and fixed more or less by the large caput, extraction was both difficult and dangerous.

Richter claims that the danger from sepsis in the Sänger operation lies in infection from the uterine cavity. This is minimized by withdrawing the uterus entirely from the abdominal cavity before cutting it. Contact of the amniotic fluid with the peritoneum is guarded against by hot pads and compresses. A careful cleansing of the uterine cavity will then reduce the danger of sepsis to a marked degree. The danger of peritonitis at this early period is small as the peritoneum is capable of dealing successfully with a moderate amount of septic material.

The most experienced operator is unable to assure himself that he will be able to deliver the fœtus extraperitoneally in a given case. The most common difficulties are a low insertion of the plica, the difficulty of finding it, firm adherence of the peritoneum to the uterus, and a decreased elasticity of the lateral vesical ligaments. Owing to the extensive exposure of the pelvic connective tissues, the accidental or intentional opening of the peritoneal cavity exposes the patient to a far greater danger than in the older method. Until a technique is developed assuring the operator of an extraperitoneal delivery, the newer operation must be considered of secondary value.

Herbert M. Stowe.

The Proof of Hemolytic Substances in the Placenta (Zum Nachweis Hemolytischer Stoffe in der Placenta). Dr. E. V. Graff. *Monatsh. für Geburt. und Gynæk.*, b. xxxii, h. 2.

Freund was able to demonstrate that the extract of the placenta of the eclamptic has hemolytic power. He used this fact as a support for his well-known eclampsia theory, especially in the cases accompanied by hemoglobinuria and hæmorrhagic diathesis. The hemolysis is produced by the presence of oleic acid.

Graff was able to demonstrate that the hemolytic

action of the extract of a normal placenta and that of a placenta of an eclamptic woman is about the same, there is no increase in the hemolytic power of the latter to be observed. This result in combination with the chemical findings of Polano, who showed that the oleic acid is present in equal quantity in the extract of the normal and the eclamptic placenta, aroused the author's doubt as to the correctness of Freund's theory. For his experiments Graff used a certain amount of suspension of washed red blood cells of a healthy woman after labor and a decreasing amount of the emulsion of the placenta extract.

Amount of emulsion	1.00	0.5	0.1	0.05	0.001	0.005
Normal placenta	compl. lysis	partial lysis	0	0	0	0
Normal placenta	compl. lysis	lysis	lysis	partial	0	
Normal placenta	lysis	lysis	lysis	partial	0	
Placenta of eclampsia	lysis	lysis	partial lysis	partial		
Placenta of eclampsia	lysis	lysis	partial lysis	0		
Placenta of eclampsia	lysis	lysis	partial lysis	0		
Placenta of eclampsia	lysis	lysis	lysis	partial		

HELIODOR SCHILLER.

Hypoplasia and Infantilism in Obstetrics and Gynecology (Hypoplasie und Infantilismus in Geburtshilfe und Gynäkologie). AUGUST MAYER. *Beiträge zur Geburtshilfe und Gynäkologie*, bd. 15, h. 3.

Infantilism is the abnormal permanence in adult life of many physical characteristics that belong to childhood. The condition is general, affecting many organs of the body to a greater or lesser extent, interfering with their functions, their development and structures. Many operative measures intended to relieve or cure the condition fail because the general underlying condition has been unrecognized.

The menstrual function is often seriously disturbed. Menstruation may be entirely absent, it may be late, or it may be replaced by molimia. In such cases considerable harm has been done by injudicious dilatation and curettage and other local treatments. Frequently, a severe degree of dysmenorrhœa is accompanied by headaches, nausea, vomiting, colic, and general weakness and prostration. A healthy girl is soon transformed into an anemic skeleton. The cause of the dysmenorrhœa does not consist of deficient uterine function but in a coexisting neurasthenia or hysteria and lowered physical vitality.

Marital relations are often accompanied by suffering and distress that increase in severity until the patient becomes an invalid. In these cases as well, local treatment and operation are generally useless.

If pregnancy should occur, abortion is a common termination. The cause lies in the slow reaction of the infantile uterus to the changes of pregnancy. In other words, the decreased elasticity of the uterine wall prevents it from keeping pace with the more rapid growth of the ovum, and separation of the decidua with hæmorrhage results.

If the pregnancy continues, a tendency to uterine rupture has been observed when the ovum becomes implanted in the fundus. A rapid dehiscence or thinning of the uterine wall occurs by being stretched over the ovum. In other cases, the infantile organism is hypersensitive and reacts energetically to every sensitive impression. Irritation of the nervous system and all local genital sensations lead to emesis and hyperemesis.

In labor, the cervix yields to the fœtal axis pressure with great relutance. The rigid condition leads to a high position of the head and predisposes to malpresentations. The resistance of the soft tissues combined with the maldeveloped musculature of the uterine fundus delay the labor materially and often necessitate an operative delivery. The infantile individual with her weakened constitution and hypoplastic heart is less able to combat infection or withstand operative interference. If the fœtal head passes through the inlet spontaneously or artificially, there is added danger of cervical, vaginal, and perineal lacerations because of the rigidity of these tissues. An injury to an infantile pelvic floor leads to connective tissue atrophy and subsequent prolapsus of the pelvic organs.

The third stage is associated with uterine atony. The increased anteflexion and decreased development of the cervix leads to placental retention.

In the puerperium, deficient uterine and abdominal walls are barriers against normal involution. Neurasthenia and enteroptosis are common. It is often impossible to nurse the child as the breasts are unable to functionate properly.

The author gives a detailed account of the various anatomical changes characteristic of infantilism to which the reader is referred for further reference.

Regarding the treatment, little can be said. Many cases are practically incurable. In others, an outdoor life, physical exercises, and an abundance of nutritious food are suggestive. Generally speaking, a woman who gives birth at full term to a child less than forty-seven centimeters in length and weighing less than 1900 grams is an infantile individual.

HERBERT M. STOWE.

BOOK REVIEWS

GYNECOLOGICAL DIAGNOSIS. By Walter L. Burrage, A. M., M. D. New York and London: D. Appleton & Company, 1910.

Gynecological diagnoses as set forth by the excellent works of Winter, Amann, Abel, Finley, and others have been indispensable to the specialist and the expert, and accordingly from this limited source have received generous and merited recognition. On the other hand, these works are so highly technical and academic in the laboratory sense that relatively they have found little favor with the great majority of physicians, who necessarily must depend for everyday diagnosis rather upon ordinary bedside and office observations than upon the laboratory findings of the pathological expert. While Burrage in no respect undervalues the pathological work of the laboratory, he says, "the methods and procedures of the pathological and bacteriological laboratories have been omitted in this work because of the assumption that the physician in making a diagnosis has always at his command the services of a trained pathologist and bacteriologist, or can consult text-books devoted exclusively to these subjects." Together with this disclaimer he wisely adds another in the expressed attempt "to keep in the background the rare diseases which are of so much interest to the pathologist and to give prominence to the common affections usually met by the general practitioner." Using the word "clinical" therefore in the popular sense, the book has been entirely written from the clinical point of view. It would however, be an inexcusable error to infer from the preceding statement that the work is not scientific, for throughout it bears abundant evidence of scientific excellence in the presentation of intensely practical matter. Anatomical essentials and sound pathological views are summarized under each subject, and differential diagnoses are clearly presented to the ready grasp of the reader in tabular form. Diagnoses of vesical, rectal, and mammary disorders, and gynecological disorders of infancy and childhood, so often neglected, are given special and practical prominence. An alphabetical index of the two hundred and seven illustrations, many of which have been especially made for the book, and a very painstaking index, will save much time and annoyance to the reader.

The author's preface contains an ultra modest statement as follows: "The views here expressed and the methods described are those which have found favor in my practice, and they are put forward, not with the feeling that they are new or original or all inclusive, but that having proved useful to me, they may help others also to unravel the knotty problems of gynecology." I would amplify and strengthen the above statement substantially as follows: The views here expressed and the methods described have the endorsement of the foremost clinicians in this department of medicine; they are put forward by an author who has enjoyed a close careful extensive experience and has brought to bear in the presentation of the whole subject an exceptional power of clear, concise, accurate, adequate, and often original statement. The book will be found very useful as a supplement to general works on diseases of women. Any physician who will read it intelligently and thoroughly may place himself thereby abreast of the time in his clinical grasp of gynecological diagnosis.

E. C. DUDLEY.

MEDICAL CHAOS AND CRIME. By Norman Barnesby, M. D. London and New York: Mitchell Kennerley, 1910.

This book is a muck-rake performance in medical literature conceived without loving purpose and brought forth without adequate gestation, a sort of literary hemiteratic abortion. The author shows some ability to use the library for his purpose but not always wisely.

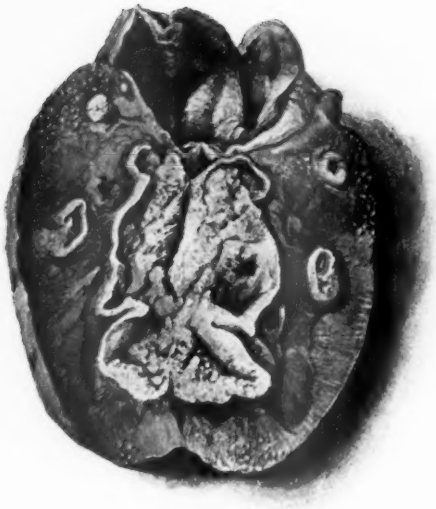
The very exceptions to professional rectitude which are recorded so gloatingly only form the rule. Not a single chapter is fairly presented. The most dastardly stated indictment against any class of medical men is made in chapter twelve. The following chapter on hospital abuses has been published in the Forum, October, 1910.

Norman Barnesby has contributed two articles to medical literature, Treatment of Lupus, Med. Mirror, St. Louis, 1903, vol. 14, pp. 382–386, and An Improved Needle Holder, Jour. Am. Med. Assn., vol. 45, p. 329. It would be more consistent with good taste if this book had been kept on the skids until the author had contributed something valuable and constructive to the profession from which he has with all of us received such an endowment of ethical precedent, scientific knowledge, and therapeutic ceremonial. May he live long enough to make us forget this monstrosity in his many good works and good words for constructive medicine.

BAYARD HOLMES.

BOOKS RECEIVED

PRINCIPLES OF PUBLIC HEALTH. By Thomas D. Tuttle, B. S., M. D. Yonkers-on-Hudson, New York: World Book Company, 1910.



One and one-half years' treatment with tuberculin. Nephrectomy. (Case of A. J., 30 years of age.)

Six months' treatment with tuberculin. Nephrectomy. (Case of M. S., 22 years of age.)